Association of
PROFESSIONAL ENGINEERS & GEOSCIENTISTS
of British Columbia

APEGBC Council Meetings

Friday, November 25, 2016

Location:

Whistler Boardroom, 2nd Floor
APEGBC Offices, 200 – 4010 Regent Street, Burnaby, BC

Meeting Schedule:

08:30 – 10:00	**Eli Mina Training Session**
10:00 – 11:00	**Closed Session**
11:00 – 11:15	Morning Break
11:15– 12:45	**Open Session**
12:45 – 14:00	Council Photo followed by Lunch
14:00 – 15:00	**Eli Mina Training Session (continued)**
15:00 – 15:15	Break Between Sessions
15:15 – 16:00	**In-Camera Session**

For more information, contact Sarah Wray at swray@apeg.bc.ca or 604.412.4896.

Association of
PROFESSIONAL ENGINEERS & GEOSCIENTISTS
of British Columbia

Council Agenda – Open Session

Friday, November 25, 2016
Whistler Boardroom, 2nd Floor
APEGBC Offices, 200 – 4010 Regent Street, Burnaby, BC
11:15 – 12:45

11:15 (5 min) **4. OPEN SESSION CALL TO ORDER**

Chair: Bob Stewart, P.Eng. President

4.1. Declaration of Conflict of Interest

11:20 (15 min) **5. OPEN CONSENT AGENDA**

MOTION: That Council approve all items (5.1 to 5.10) on the Open Consent Agenda.

5.1. October 22, 2016 Open Minutes — Open Minutes Oct 22, 2016

MOTION: That Council approve the October 22, 2016 Open Meeting minutes as circulated.

5.2. Appointments Approval

MOTION: That Council approves the recommended appointments and re-appointments to APEGBC Volunteer Groups and to outside Organizations, as applicable.

5.3. AGM Motions — AGM Motions

MOTION: That Council approves the recommendations for considering the member motions of the 2016 AGM as circulated.

Janet Sinclair, Chief Operating Officer

5.4. Branch/Councillor Pairings — Branch/Councillor Pairings

MOTION: That Council approves the 2016/2017 Branch/Councillor pairings.

Deesh Olychick, Director of Member Services

5.5. Financials as at September 30, 2016 — Financial Update

MOTION: That Council receives the APEGBC financial results as at September 30, 2016.

Jennifer Cho, CPA, CGA, Director of Finance and Administration

5.6. Executive Committee

5.6.1. Budget Guidelines

Budget Guidelines

MOTION: That Council approves the 2017/2018 budget guidelines, as presented.

5.7. Update to Policy Re: Applicants whose Discipline of Practice/Experience is Different from their Discipline of Academic Qualification

Update to Policy

MOTION: That Council approve the changes to the Policy on Applicants whose Discipline of Practice/Experience is Different from their Discipline of Academic Qualification.

Cassandra Hall, P.Geo., P.Eng., Chair of the Registration Committee

5.8. Update to Policy on Selection and Training of Registration Volunteers and Staff

Update to Policy

MOTION: That Council approves the modifications to the Policy on Selection and Training of Registration Volunteers and Staff.

Cassandra Hall, P.Geo., P.Eng., Chair of the Registration Committee

5.9. Revisions to the APEGBC Professional Practice Guidelines – Legislated Dam Safety Reviews in BC

Revision to Guideline

MOTION: That Council approve the *APEGBC Professional Practice Guidelines – Legislated Dam Safety Reviews in BC* for final editorial and legal review prior to publication.

Peter Mitchell, P.Eng., Director of Professional Practice, Standard & Development

5.10. Information Reports

MOTION: That Council receives the following informational reports.

5.10.1. CEO & Registrar Report

CEO & Registrar Rpt

Ann English, P.Eng., CEO & Registrar

5.10.2. Branch Engagement Report

Branch Engagement Rpt

Deesh Olychick, Director of Member Services

5.10.3. Engineers Canada Director's Report — Engineers Canada Directors Rpt

Russ Kinghorn, P.Eng., FEC, FGC (Hon.), APEGBC Director to Engineers Canada

Jeff Holm, P.Eng., FEC, FGC (Hon.), APEGBC Director to Engineers Canada

5.10.4. Update on National Competency-Based Assessment — Update on NCBA

Gillian Pichler, P.Eng., Director of Registration

5.10.5. Report on APEGBC's Role in Geoscience Competency Assessment — Report on GCA

Gillian Pichler, P.Eng., Director of Registration

5.10.6. Report on Enforcement Outreach Activities — Enforcement Rpt

Efrem Swartz, LLB, Director of Legislation, Ethics and Compliance

5.10.7. Investigation and Discipline Committee Report — Investigation and Discipline Rpt

Efrem Swartz, LLB, Director of Legislation, Ethics and Compliance

5.10.8. Corporate Engagement Update — Corp Engagement Update

Melinda Lau, Acting Director of Communications and Stakeholder Engagement

5.10.9. APEGBC Road Map for 2016-2017 — Road Map

Ann English, P.Eng., CEO & Registrar

5.10.10. Council Attendance Summary — Council Attendance Summary

Ann English, P.Eng., CEO & Registrar

11:35 **6. OPEN REGULAR AGENDA**

MOTION: That Council approve the Open Regular Agenda (with any additions from the Consent Agenda).

11:35

(20 min)

6.1. APEGBC Election and Nomination Processes — Election and Nom Process

MOTION: That Council approve the creation of a Task Force to review the nomination processes and direct staff to create a Terms of Reference for the Task Force.

Deesh Olychick, Director of Member Services

11:55 **(20 min)**	**6.2.**	Renewal of Memorandum of Agreement with Iranian Engineers of British Columbia (IEBCA) **MOTION: That Council approve the renewal of the Memorandum of Agreement with IEBCA (the MOA) and that the President be authorized to execute the MOA on behalf of APEGBC.** *Gillian Pichler, P.Eng., FEC, FGC (Hon.), Director of Registration*	Renew MOA with IEBCA
12:15 **(30 min)**	**6.3.**	Presentation to the Federal Expert Panel Reviewing the Canadian Environmental Assessment Processes *Harshan Radhakrishnan, P.Eng., Practice Advisor, Professional Practice, Standards and Development*	Cdn Enviro Assess Process
12:45 **(75 min)**		**End of Open Session and Lunch Break** **(Council photo will be taken at this time)**	

MINUTES OF THE OPEN SESSION OF THE FIRST MEETING OF THE 2016/2017 COUNCIL of the Association of Professional Engineers and Geoscientists of British Columbia,
held on OCTOBER 22, 2016 in the SAANICH ROOM, VICTORIA CONFERENCE CENTRE, VICTORIA, BC

Present

Council	
Bob Stewart, P.Eng.	President (Chair) (2016/2017)
Dr. Ed Casas, P.Eng.	Vice President (2016/2017)
Dr. Mike Wrinch, P.Eng., FEC, FGC (Hon.)	Past President (2016/2017)
Kathy Tarnai-Lokhorst, P.Eng., FEC	Councillor (2016/2017)
John Turner, P.Ag. (ret.)	Councillor (2016/2017)
Ken Laloge, CPA, CA, TEP	Councillor (2016/2017)
Chris Moser, P.Eng.	Councillor (2016/2017)
Ana Fernandes, CIM, FCSI	Councillor (2016/2017)
Richard Farbridge, P.Eng.	Councillor (2016/2017)
Caroline Andrewes, P.Eng., CPA, CMA	Councillor (2016/2017)
Scott Martin, P.Eng.	Councillor (2016/2017)
Cassandra Hall, P.Eng., P.Geo.	Councillor (2016/2017)
Larry Spence, P.Eng.	Councillor (2016/2017)
Ross Rettie, P.Eng., FEC	Councillor (2016/2017)
Brock Nanson, P.Eng.	Councillor (2016/2017)
Susan Hayes, P.Eng.	Councillor (2016/2017)
Guests	
Russ Kinghorn, P.Eng., FEC, FGC (Hon.)	APEGBC Director to Engineers Canada
Jeff Holm, P.Eng., FEC, FGC (Hon.)	APEGBC Director to Engineers Canada
Staff	
Ann English, P.Eng.	Chief Executive Officer & Registrar
Tony Chong, P.Eng.	Chief Regulatory Officer & Deputy Registrar
Janet Sinclair	Chief Operating Officer
Jennifer Cho, CGA, CPA	Director - Finance & Administration
Vincent Lai, CGA, CPA	Associate Director – Finance & Administration
Gillian Pichler, P.Eng.	Director - Registration
Mark Rigolo, P.Eng.	Associate Director – Engineering Admissions, Registration
Don Gamble	Director - Information Systems
Efrem Swartz, LLB	Director - Legislation, Ethics & Compliance
Peter Mitchell, P.Eng.	Director – Professional Practice, Standards & Development
Taymaz Rastin, LLB	Staff Lawyer
Melinda Lau	Acting Director – Communications & Stakeholders Engagement
Deesh Olychick	Director – Member Services
Sarah Wray	Executive Assistant to Council and to the Chief Executive Officer & Registrar
Regrets	
Taj Mitha, LLB	Councillor (2016/2017)

OPEN SESSION – CALL TO ORDER

Bob Stewart, P.Eng., President and Chair, called the meeting to order at 3:00 pm.

CO-17-01 SIGNING OF THE OATH OR AFFIRMATION OF OFFICE

The 2016/2017 Council signed the Oath or Affirmation of Office in the presence of the Directors of Engineers Canada and the staff. Vice President Casas and Councillor Rettie declined to sign the Oath or Affirmation of Office. President Stewart presented a letter of notice to Vice President Casas and Councillor Rettie signed a Declaration of Confidentiality Agreement (These two separate documents can be made available upon request).

CO-17-02 OPEN REGULAR AGENDA

MOTION **It was moved and seconded that the Inaugural Council Open meeting agenda be approved.**
CARRIED

CO-17-03 PRESIDENT'S REMARKS

Bob Stewart, P.Eng., President and Chair, opened the meeting with a short introduction and his hopes for the coming Council year.

CO-17-04 ROUNDTABLE SELF-INTRODUCTIONS OF COUNCIL AND STAFF

The Chair led a roundtable of Council, staff and guest self-introductions.

CO-17-05 INSIGHTS AND OBSERVATIONS ON THE AGM

The following AGM Insights and Observations were received:

- It was noted this was the first year in some time that the Councillors had been seated together near the front of the room and it was found to be very effective.
- It was noted the speech delivered by Ralph Sultan was excellent and resonated with many in attendance.
- It was noted that Dr. Mike Wrinch, P.Eng., FEC, FGC (Hon.) did an excellent job.
- It was noted that alerting the members in attendance to the restarting of the meeting after the break could have been done better. As a result, the meeting was restarted almost 15 minutes late.
- It was noted that some of the movers of the motions seemed to be taken aback by the wording of their motions after the break. It was clarified by staff that all of the movers were spoken to regarding the minor wording changes and had approved of them prior to the posting of the motions on the big screen.
- It was noted it was very beneficial to have Chris Roney and Oliver Bonham at the meeting to deliver greetings from Engineers Canada and Geoscientists Canada. It was good to hear their perspectives.

CO-17-06 NOTE OF APPRECIATION TO STAFF

MOTION **It was moved and seconded that Council congratulates staff for a successful annual conference and AGM and expresses sincere appreciation for the hard work and commitment that ensure the success of this event.**
CARRIED

END OF OPEN SESSION

The Open Session ended at 3:29 pm.

OPEN SESSION – CONTINUED

Bob Stewart, President and Chair, called the continued Open Session meeting to order at 3:48 pm.

CO-17-10 APPROVAL OF COUNCIL APPOINTMENTS TO COMMITTEES

MOTION **It was moved and seconded that Council accepts the recommended appointments and reappointments to APEGBC Committees, Volunteer Groups and to outside Organizations, as applicable, as circulated. CARRIED**

The list of appointments is as follows:

Executive Committee **Membership: President, Past President, Vice President, and two Councillors (one a government appointee)**			
Bob Stewart, P.Eng., President	Mandated	October 22, 2016	October 21, 2017
Ed Casas, P.Eng., Vice President	Mandated	October 22, 2016	October 21, 2017
Dr. Mike Wrinch, P.Eng., FEC, FGC (Hon.), Immediate Past President	Mandated	October 22, 2016	October 21, 2017
Ken Laloge - member at large, Government Appointee	1 Year	October 22, 2016	October 21, 2017
Kathy Tarnai-Lokhorst, P.Eng., FEC	1 Year	October 22, 2016	October 21, 2017

Governance Committee **Membership: Immediate Past President and up to five other Councillors (Chair is appointed by Council upon recommendation of the Committee)**			
Dr. Mike Wrinch, P.Eng., FEC, FGC (Hon.), Immediate Past President	Mandated	October 22, 2016	October 21, 2017
John Turner, P.Ag. (ret.)	1 Year	October 22, 2016	October 21, 2017
Chris Moser, P.Eng.	1 Year	October 22, 2016	October 21, 2017
Caroline Andrewes, P.Eng.	1 Year	October 22, 2016	October 21, 2017

Richard Farbridge, P.Eng.	1 Year	October 22, 2016	October 21, 2017

Audit Committee **Membership: Five Councillors including at least two government appointees and the remainder not on the Executive Committee**			
Ken Laloge, CPA, CA, TEP, Government Appointee	1 Year	October 22, 2016	October 21, 2017
Ana Fernandes, CIM, FCSI	1 Year	October 22, 2016	October 21, 2017
Caroline Andrewes, P.Eng.	1 Year	October 22, 2016	October 21, 2017
Richard Farbridge, P.Eng.	1 Year	October 22, 2016	October 21, 2017
Chris Moser, P.Eng.	1 Year	October 22, 2016	October 21, 2017

Registration Committee **Membership: Five Councillors with one serving as Chair (Council designates the Chair)**			
Larry Spence, P.Eng.	1 Year	October 22, 2016	October 21, 2017
Brock Nanson, P.Eng.	1 Year	October 22, 2016	October 21, 2017
Ross Rettie, P.Eng., FEC	1 Year	October 22, 2016	October 21, 2017
Cassandra Hall, P.Geo., P.Eng.	1 Year	October 22, 2016	October 21, 2017

Geoscience Committee **Membership: Two Councillors (Chair is appointed by Council upon recommendation of the Committee)**			
Cassandra Hall, P.Eng., P.Geo.	1 Year	October 22, 2016	October 21, 2017
Scott Martin, P.Eng.	1 Year	October 22, 2016	October 21, 2017

Professional Practice Committee **Membership: At least two Councillors (Council designates the Chair)**			
Ross Rettie, P.Eng., FEC	1 Year	October 22, 2016	October 21, 2017
Larry Spence, P.Eng.	1 Year	October 22, 2016	October 21, 2017
Susan Hayes, P.Eng.	1 Year	October 22, 2016	October 21, 2017
Taj Mitha, LLB	1 Year	October 22, 2016	October 21, 2017

Nominating Committee **Membership: Immediate Past President (Chair is the Immediate Past President)**			
Dr. Mike Wrinch, P.Eng., FEC, FGC (Hon.), Immediate Past President	Mandated	October 22, 2016	October 21, 2017

Climate Change Advisory Group **Membership: One Councillor (Chair is appointed by Council but does not need to be a Councillor)**			
Susan Hayes, P.Eng.	1 Year	October 22, 2016	October 21, 2017

Foundation Nominating Committee **Membership: Three Councillors (Chair is appointed by the Committee but Chair must be, and remain, a member of Council)**			
Taj Mitha, LLB	1 Year	October 22, 2016	October 21, 2017
Brock Nanson, P.Eng.	1 Year	October 22, 2016	October 21, 2017
Ana Fernandes, CIM, FCSI	1 Year	October 22, 2016	October 21, 2017

Advisory Task Force on Corporate Practice **Membership: Two Councillors (one being a government appointee, the other must serve on the Professional Practice Committee). The terms of office are until December 2016 or later as directed by Council)**			
John Turner, P.Ag. (ret.)	December 2016 or later (per above note)	October 20, 2015	December 2016 or later (per above note)
Scott Martin, P.Eng.	December 2016 or later (per above note)	October 20, 2015	December 2016 or later (per above note)

ASTTBC/APEGBC Joint Board **Membership: Council to appoint three members including one member of Council (the current Council members will be Co-Chairs)**			
Kathy Tarnai-Lokhorst, P.Eng., FEC	1 Year	October 22, 2016	October 21, 2017
Andy Mill, P.Eng., Struct.Eng., FEC	1 Year	October 22, 2016	October 21, 2017
Colin Smith, P.Eng., FEC, FGC (Hon.)	1 Year	October 22, 2016	October 21, 2017

END OF OPEN SESSION

The Open Session ended at 4:00 pm.

Date: November 14, 2016

Report to: **Council for Decision**

From: Janet Sinclair
Chief Operating Officer

Subject: Council Consideration of 2016 AGM Motions

Linkage to Strategic Plan: Continue to implement best practices in governance.

Purpose:	To determine the process through which member motions from the AGM will be considered.
Motion:	That Council approves the recommendations as circulated for consideration of the 2016 AGM member motions.

Background

At the Annual General Meeting APEGBC members and licensees have an opportunity to put forward motions for Council consideration. These motions are not binding on Council, but rather provide input to Council on the actions that those members present at the AGM would like Council to undertake.

Motions are referred for further study, so that Council may receive the benefit of the expertise of relevant committees, staff and others before making a decision on the motion. This report sets out recommendations as to where this year's motions could be referred and sets timelines for delivery of the recommendations to Council.

Discussion

This year three motions were considered by the membership at the AGM, all of which were carried.

The motions are presented below as are recommendations for action.

Motion 1

That Council consider developing a proactive guideline that will require all members to take into consideration options to achieve net zero emissions in their professional practice.

The motion was **carried.**

Recommended Action:

One of the activities of the Climate Change Advisory Group (CCAG) is to consider climate change mitigation. As such, it is recommended that the CCAG be asked to report to Council on current activities being undertaken related to guideline development in this area and to provide advice with respect to any additional considerations regarding this motion. The report should be provided by the April 2017 meeting of Council.

Motion 2

That Council consider reporting the results of membership voting by branch, which then would be aggregated to the total returns.

The motion was **carried.**

Recommended Action:

It is recommended that this motion be referred to the Director of Member Services to provide an analysis of what information is possible to obtain. A report with recommendations is to be provided to Council at its February 2017 meeting.

Motion 3

That, in the interest of improved openness and transparency with the membership and the public, Council consider implementing a policy of publishing, both in Innovation and by broadcasting to the membership by email, any received written request signed by 25 members [pursuant to section 12(7) of the Engineers and Geoscientists Act] at the earliest possible opportunity.

The motion was **carried.**

Recommended Action:

It is recommended that this motion be referred to the Executive Committee so that a recommendation along with a fulsome analysis of the pros and cons of publication can be presented to Council at its February 2017 meeting.

Recommendation

MOTION: That the recommendations for considering the member motions of the 2016 AGM be approved as circulated.

Date: November 10, 2016

Report to: **Council for Decision**

From: Deesh Olychick
Director of Member Services

Subject: Branch/Councillor Pairings for 2016/2017

Linkage to Strategic Plan: Provide effective support and recognition for volunteers and staff.

Purpose:	To approve the 2016/2017 Branch/Councillor pairings as circulated.
Motion:	That Council approves the 2016/2017 Branch/Councillor pairings.

Professional Engineers and Geoscientists of BC

Branch/Councillor Pairing 2016/2017

The Branch/Councillor Pairings facilitate communication between the branches and Council by providing the Branch Executives with one or two Councillors that they can contact concerning Council matters.

Councillors are not required to attend all branch meetings, but attend when they can, either in person or via teleconference, and will be placed on the branch's emailing list for upcoming events and meetings.

BRANCH	STAFF SUPPORT	COUNCILLOR	BRANCH CHAIR
Burnaby/New West	Tim Verigin	Caroline Andrewes, P.Eng. Dr. Ed Casas, P.Eng.	Niankun Rao, EIT
Central Interior	Mara Buzgar	Richard Farbridge, P.Eng.	Lee Peltz, P.Eng.
East Kootenay	Mara Buzgar	Larry Spence, P.Eng.	Jeremy Zandbergen, P.Eng.
Fraser Valley	Tim Verigin	Chris Moser, P.Eng.	Ria Bhagnari, EIT
Northern	Mara Buzgar	John Turner, P.Ag. (ret.)	Anastasia Ledwon, P.Geo. and Rhonda Mellafont, P.Geo.
Okanagan	Mara Buzgar	Ken Laloge, CPA, CA, TEP	James Barr, P.Geo.
Peace River	Mara Buzgar	Dr. Mike Wrinch, P.Eng., FEC, FGC (Hon.)	Christopher Flury, P.Eng.
Richmond/Delta	Tim Verigin	Richard Farbridge, P.Eng. Ross Rettie, P.Eng., FEC	Fardin Barekat, EIT
Sea to Sky	Tim Verigin	Cassandra Hall, P.Geo., P.Eng. David J. P. Wells	Vadim Airiants, P.Eng.
South Central	Mara Buzgar	Scott Martin, P.Eng. Brock Nanson, P.Eng.	Deanna Erickson, EIT
Tri-City	Tim Verigin	Bob Stewart, P.Eng.	Jane Guo, P.Eng.
Vancouver	Tim Verigin	Dr. Mike Wrinch, P.Eng., FEC, FGC (Hon.) Suky Cheema, CA, CPA	Keith Martin, P.Eng.
Vancouver Island	Mara Buzgar	Kathy Tarnai-Lokhorst, P.Eng., FEC John Turner, P.Ag. (ret.)	Jarrod Koster, P.Eng.
Victoria	Mara Buzgar	Kathy Tarnai-Lokhorst, P.Eng., FEC Susan Hayes, P.Eng.	Rob McDermot, P.Eng.
West Kootenay	Mara Buzgar	Larry Spence, P.Eng.	Stefan Humphries, P.Geo.

Tim Verigin: 604-412-4872
tverigin@apeg.bc.ca

Mara Buzgar: 604-412-8176
mbuzgar@apeg.bc.ca

Date: November 16, 2016

Report to: **Council for Information**

From: Jennifer Cho, CPA, CGA
Director of Finance and Administration

Subject: Financial Results as at September 30, 2016

Linkage to Strategic Plan: Continue to implement best practices in governance.

Purpose:	For Council to review the first quarter financial results.
Motion:	That Council receive the APEGBC financial results as at September 30, 2016.

Background

As approved by Council at the September 12, 2014 meeting, quarterly financial reports will be made to the Executive Committee for review. The Committee reviewed the information at their November 16, 2016 meeting and had agreed that the information package submitted was sufficient. The same information package was provided to the Audit Committee for information.

Discussion

Reported below is an update on the financial status to Sep 30, 2016. This update includes a comparison of year-to-date actual results to budget, with a summary of major variances.

	A	B	C	D	E	F
1		YTD			Annual Prior Year Actual	FY2017 Budget
2		Actual	Budget	Variance		
3	**REVENUE**					
4	Members	2,469	2,470	(1)	9,614	9,577
5	Others	1,043	1,003	40	4,660	4,677
6	**Total Revenue**	**3,513**	**3,474**	**39**	**14,274**	**14,255**
7						
8	**EXPENDITURES**					
9	Operating	2,803	3,399	(596)	13,844	14,474
10	**Operating Income Before External Contracts**	**710**	**75**	**635**	**430**	**(220)**
11						
12	**EXTERNAL CONTRACTS**					
13	Revenue	232	280	(48)	1,174	1,120
14	Expenditures	212	260	(48)	1,064	1,040
15	**Operating Income - External Contracts**	**20**	**20**	**0**	**110**	**80**
16						
17	**Net Operating Income Before Appropriations**	**730**	**95**	**635**	**540**	**(140)**

YEAR-TO-DATE REVIEW - BEFORE EXTERNAL CONTRACTS

MEMBER FEES & OTHER REVENUES

Total revenues are $39K (cell D6) over budget, primarily due to:

- OQM revenue- stronger volume in annual OQM revenue collection

Offset by:

- PD revenue - variance due to cancellation in July and August
- Application/registration - due to lower volume in application fee from EIT to Professional and certification volume.

EXPENDITURES

Expenditures are $596K (cell D9) below budget primarily due to:

- Savings in salaries and benefits primarily due to unfilled positions
- Savings in IT system maintenance and legal expenses using in-house IT and legal staff

YEAR-TO-DATE REVIEW – EXTERNAL CONTRACTS

The YTD contribution margin is on track towards annual budget.

Recommendation

That Council receive the APEGBC financial results as at September 30, 2016.

Date: November 16, 2016

Report to: **Council for Decision**

From: Executive Committee

Subject: APEGBC 2017/18 Budget Guidelines

Linkage to the Strategic Plan: Continue to implement best practices in governance.

Purpose:	To have Council review and approve the 2017/18 budget guidelines.
Motion:	That Council approve the 2017/18 budget guidelines, as presented.

Background

At the September 13, 2013 Council meeting, Council approved to adopt a new planning process that aligns the three year strategic plan with a three year budget. Some of the main reasons and benefits of a three year budget are as follows:

- A three year budget ensures that strategic initiatives that span fiscal years can be funded beyond fiscal year boundaries without disruption to the schedule that is associated with annual budget approvals.
- Contingencies associated with specific initiatives are reduced as there is greater certainty around future commitments.
- Greater predictability of budget and fee increases (if any).
- Council passes a three year strategic plan that is linked with an associated three year budget. At the end of Year 1 and 2, the budget can be adjusted with corresponding updates to the plan.
- Overall, longer term and truly strategic planning is more achievable.

As such, the new 2018-2020 strategic plan will also be aligned with a new three year budget. 2016 marks the year that the planning of a three year budget will occur. The Executive Committee reviewed the draft budget guidelines on November 16, 2016 and recommends that Council approve the attached guidelines as presented.

Discussion

Outlined below are the draft of the 2017/18 fiscal year budget guidelines for your review and approval.

APEGBC 2017/18 Draft Budget Guidelines

1. The Sustainable Financial Management Policy (Appendix I) will be the foundation for guiding budget preparation.

2. Apply the APEGBC Strategic Plan, Council Work Plan (Roadmap) and Key Performance Indicators to budget development.

3. Strive to keep the overall budget increase to be less than 5% each year.

4. Strive for no more than a 2% increase of the annual professional member fee increase for 2018-2020.

5. Consider potential changes to prior year budget as follows: Opportunities for efficiencies by program & department; new program initiatives/ non-discretionary budget changes.

6. Review and assess the requirements and appropriate level of funding for the General Operating Fund, Property, Equipment and Systems Replacement Fund and the Legal and Insurance Fund.

7. Staffing levels be generally determined by authorized program improvements, growth and membership count.

8. Review program contribution margins and strive for financial self-sustainability on a direct cost basis.

9. Final 2017/2018 budget approval and 2018/19 and 2019/2020 proforma budget should be sought at the Council meeting in April 2017.

10. That an annual capital replacement transfer be considered.

Recommendation

Motion: That Council approves the 2017/18 budget guideline, as presented.

Appendix I:

Principle: The 2017/2018 Budget will be based on the Sustainable Financial Management Policy:

The Foundations of the Policy are:

1.1. All initiatives and financial expenditures are aligned to the Strategic Plan.
1.2. There is an annual review of economies, efficiencies and effectiveness of current expenditures, revenue strategies and initiatives.
1.3. The Applications and Registration program (the intake process) will be financially self-sustaining on a direct cost basis.
1.4. The Continuing Professional Development instructional and service delivery be financially self-sustaining on a direct cost basis.
1.5 All other programs with direct revenues should be financially self-sustaining on a direct cost basis.
1.6 Membership growth is actively pursued.
1.7 The annual member fee is reviewed each year.

Date: November 10, 2016

Report to: **Council for Decision**

From: Cassandra Hall, P.Eng./P.Geo., Member of Council
Chair of the Registration Committee

Issue: Revisions to Policy on Applicants whose Discipline of Practice/Experience is Different from their Discipline Of Academic Qualification

Linkage to the Strategic Plan: Members and Future Members

Purpose:	To revise the policy to deal with applicants whose discipline of practice/experience is different from their discipline of academic qualification more effectively
Motion:	That Council approve the changes to the Policy on Applicants whose Discipline of Practice/Experience is Different from their Discipline of Academic Qualification.

Background

The Registration Committee successfully piloted the achievement of engineering competencies as adequate proof that an otherwise academically qualified applicant whose discipline of studies is different than their discipline of practice has the knowledge and competencies to practice.

At the June 17, 2016 meeting, Council approved changes to the Policy on Applicants whose Discipline of Practice/Experience is Different from their Discipline of Academic Qualification to reflect this. However, this created a potential for unfair treatment of applicants who did not have the opportunity to use the competency experience reporting system.

The Registration Committee requested that staff draft changes to the policy to reflect this finding. It also requested that the policy reflect the findings and applicant precedents in the recommendations of the Interdisciplinary Review Panel (the Panel) with respect to applicants who are practising in interdisciplinary fields.

Discussion

The Registration Committee found that applicants who apply using the traditional (pre-competency) work experience reporting method and meet similar criteria to those using the competency experience reporting system have also adequately proven their competency to practice in their chosen discipline and can be treated in the same way as those using the competency reporting system.

It also found that, based on the past year of work and recommendations of its Interdisciplinary Review Panel, it is appropriate to extend this policy to applicants who are practising in inter-disciplinary fields.

Furthermore, the proposed policy and process provides a more efficient method to handle applications from applicants with low risk profiles[1] who practice in areas that do not exactly match their academic background, without having to undertake a resource-intensive detailed academic assessment of their qualifications by the Board of Examiners and interview.

The proposed revisions have been incorporated into a redlined version of the *Policy on Applicants whose Discipline of Practice/Experience is Different from their Discipline Of Academic Qualification.*

Recommendation

MOTION: That the changes to the *Policy on Applicants whose Discipline of Practice/Experience is Different from their Discipline of Academic Qualification* be approved.

Appendix A – Current Version of the Policy

Appendix B – Redlined Version of the Policy with Proposed Changes

[1] An applicant with a Low-Risk profile has:

i. More than 4 years of experience
ii. all references positive (recommending registration);
   a. all technical competencies validated by validators in the applicant's field or practice; or
   b. two or more references in the applicant's field of practice recommending registration; and
iii. Experience assessed at the required level:
   a. all competency categories achieved at the required level in the opinion of validators and two APEGBC competency assessors; or
   b. two members of the Experience Review Panel recommend registration

Date: November 15, 2016

Report to: **Council for Decision**

From: Cassandra Hall, P.Eng., P.Geo., Member of Council
Chair, Registration Committee

Subject: Updates to Policy on Selection and Training of Registration Volunteers and Staff

Linkage to Strategic Plan: Enabling: Continue to implement best practices in governance; Provide effective support and recognition for volunteers and staff.

Purpose:	Update the Policy to include Limited Licensees, Members/Licensees from other Canadian jurisdictions; and requirement for training
Motion:	That Council approves the modifications to the *Policy on Selection and Training of Registration Volunteers and Staff.*

Background

This policy sets out the minimum qualifications for Registration reviewers and interviewers and the requirement for APEGBC to allot sufficient resources for training of Registration volunteers and staff. The current wording requires that Registration volunteers who make recommendations on the qualifications of applicants for registration have five years of experience as a professional engineer or professional geoscientist and attend training in application of policy and their role as a volunteer.

The policy has recently been reviewed by the Registration Committee with respect to the requirement to be registered or licensed for five years, reference to professional engineers and professional geoscientists and not Engineering and Geoscience Licensees; and its implications for developing programs such as the Accredited Employer Member in Training Program and the piloting of APEGBC's Competency-Based Assessment system by other Canadian jurisdictions.

Discussion

The Registration Committee decided to maintain the requirement for five years of experience (licensure) as it felt that a recent licensee, regardless of years of experience or professional recognition in another jurisdiction, hasn't the knowledge of the professions in Canada instilled by an extended period of professional licensure.

Proposed changes to the policy are to:

- include Engineering and Geoscience Licensees as volunteers with reference to five years of licensure in their scope of practice when acting as reviewers or interviewers;

- include an explicit reference that Registration volunteers may be registered or licensed in other Canadian jurisdictions

    - from time to time, APEGBC calls upon the expertise of reviewers in other jurisdictions (e.g. Ontario – Nuclear; Alberta – Petroleum); and

    - The adoption of APEGBC's competency-based assessment system and framework by regulators in other provinces will require that assessors from other provinces assess APEGBC applicants as part of their training. A common assessor pool from participating jurisdictions may also become a promising practice in future; and.

- require interviewers to have taken training and change 'attended' to 'completed' training to recognize the online training provided by APEGBC..

Recommendation

That Council approves the modifications to the *Policy on Selection and Training of Registration Volunteers and Staff.*

Appendix A – Clean Version of updated *Policy on Selection and Training of Registration Volunteers and Staff*

Appendix B – Redlined Version of updated *Policy on Selection and Training of Registration Volunteers and Staff*

Date: November 14, 2016

Report to: **Council for Decision**

From: Peter R. Mitchell, P.Eng.
Director, Professional Practice, Standards & Development

Subject: Revisions to the APEGBC Professional Practice Guidelines – Legislated Dam Safety Reviews in BC

Linkage to Strategic Plan: Improve resources and education as well as awareness and access to resources that help members practice to high professional and ethical standards.

Purpose:	For Decision and Action
Motion:	That Council approve the *APEGBC Professional Practice Guidelines – Legislated Dam Safety Reviews in BC* for final editorial and legal review prior to publication.

Background

APEGBC's Professional Practice, Standards and Development (PPSD) Department focuses on the proactive regulation of professional engineering and professional geoscience. One of the important ways in which PPSD delivers on the proactive regulation of the professions is through the development of APEGBC professional practice guidelines. These guidelines identify the standard of care APEGBC professionals are expected to provide in meeting the duty of care APEGBC professionals have in law when carrying out professional activities involving the practice of professional engineering and professional geoscience.

These professional practice guidelines establish a common level of expectation, for a variety of stakeholders on what constitutes good professional practice when carrying out a particular professional activity. These stakeholders include APEGBC professionals, statutory decision makers, clients, APEGBC, the public and a variety of other groups. In 2008 APEGBC Council approved the Council Policy on the Development of APEGBC Professional Practice Guidelines.

Discussion

Shortly after the APEGBC Professional Practice Guidelines - Legislated Dam Safety Reviews in BC were published in 2014, the Mount Polley dam breach occurred and several reports were released including the Chief Inspector of Mines Report and the Auditor General's Report, which both recommended clarification of the term Engineer of Record. In particular, the Chief Inspector of Mines report specifically recommended that APEGBC address this issue. In light of these recommendations, APEGBC felt it was vital to define and provide a proper context for the term Engineer of Record. The term has been defined in the APEGBC Professional Practice Guidelines – Site Characterization for Dam Foundations in BC, however it was agreed that a section providing more context on the EOR responsibilities was better suited for the Dam Safety Review Guidelines. In addition the Mount Polley incident also resulted in changes being made to the BC Heath, Safety and Reclamation Code (Tailing Dams) and the Dam Safety Regulation (Water Dams) . Proposed revisions to these guidelines were prepared by the primary authors of the APEGBC Professional Practice Guidelines – Site Characterization for Dam Foundations in

BC and then the revisions were sent out for consultation. Those involved in this consultation process included,

- Harvey McLeod, P.Eng./P.Geo. – Klohn Crippen Berger Ltd. – Expert Author of the Site Characterization Guidelines and the APEGBC Dam Safety Reviews Guidelines.
- Andy Small, P.Eng – AMEC Foster Wheeler – Expert Author of the Site Characterization Guidelines and representative of CDA.
- Dirk Van Zyl, P.Eng., Ph.D. – UBC – Expert Author of the Site Characterization Guidelines and member of the Independent Expert Engineering Investigation and Review Panel appointed by the Province of BC to assess the cause of the Mount Polley dam breach and provide recommendations.
- Mike Noseworthy, P.Geo., Eng.L. – Forest, Lands and Natural Resources – Reviewed revisions with respect to changes made to the Dam Safety Regulation as they relate to water dams.
- Desmond Hartford, Ph.D., P.Eng. – BC Hydro – Expert author of the APEGBC Guidelines on Legislated Dam Safety Reviews. Reviewed all changes and provided valuable feedback with respect to water dams.
- Neil Heidstra, P.Eng. - Klohn Crippen Berger Ltd. – Expert author of the APEGBC Guidelines on Legislated Dam Safety Reviews. Reviewed all changes.
- Chris Carr, P.Eng. – Square Peg Enterprises – Expert author of the APEGBC Guidelines on Legislated Dam Safety Reviews. Contracted by the Ministry of Energy and Mines to review the changes.

Please note that all of the primary authors involved in the development of the APEGBC Professional Practice Guidelines - Legislated Dam Safety Reviews in BC that responded to the e-mail (4 out of 6 responded) asking for their input on the changes approved the revisions highlighted in the attached document.

The consultation process went smoothly, with all of the reviewers providing useful feedback which was incorporated into the final draft.

All of the revisions can be found in the attached document and are identified using tracked changes. Outlined below are the areas where major changes have occurred;

Definitions – added Engineer of Record and Design Engineer

Section 1.3 – added language on EOR

Section 2.2.3 – New section describing the role of the EOR.

Section 3.6 – revisions to reflect climate change impact.

Section 4.4 – Previous reference to EOR was removed as it was incorrect.

Appendix B Mining Dams – revisions based on changes to the Health, Safety and Reclamation Code

Consistent with their Terms of Reference, all APEGBC Professional Practice Guidelines must be reviewed by the Professional Practice Committee before they are submitted for the APEGBC Council for their approval. At their meeting on November 10, 2016, the APEGBC Professional Practice Committee approved the following motion: “The APEGBC Professional Practice Committee recommends that Council approve the revisions to the APEGBC Professional Practice Guidelines – Legislated Dam Safety Reviews in BC for final editorial and legal review.”

Recommendation

That Council approve the *APEGBC Professional Practice Guidelines – Site Characterization for Dam Foundations in BC* for final editorial and legal review prior to publication.

Appendix A – APEGBC Professional Practice Guidelines – Legislated Dam Safety Reviews in BC

Date: November 4, 2016

Report to: **Council for Information**

From: Ann English, P.Eng.
CEO & Registrar

Subject: CEO and Registrar Report to Council

Linkage to the Strategic Plan: Continue to implement best practices in governance.

This report summarizes activities of the Leadership Team related to the policy agenda and work implementation of the Strategic Plan and ongoing Regulatory duties of the Association since the October 22, 2016 meeting of Council.

1. Regulatory Matters

1.1 Corporate Practice

On Friday, November 4, 2016 Mike Currie, P.Eng. (Chair of the Council appointed APEGBC Advisory Task Force on Corporate Practice) received the formal submission from the Board of the Association of Consulting Engineering Companies-BC (ACEC-BC) regarding APEGBC's initiative to consider the regulation of organizations providing engineering/geoscience services and/or products. The ACEC-BC Board formed a task force in order to prepare their 8 page submission. This submission follows a presentation APEGBC staff made to the ACEC-BC Board on October 23, 2016. At that presentation the Chair of the ACEC-BC Board identified the concerns he had with APEGBC regulating engineering companies and questioned what the problem was that APEGBC was trying to solve by regulating engineering companies and why was this being looked at now.

APEGBC staff identified that there were four matters which caused the APEGBC Council to consider the issue at this point in time;

i) The practice of professional engineering and geoscience in BC is influenced at two fundamental levels:

- through individual APEGBC professionals, and
- through the organizations employing those professionals.

ii) APEGBC only regulates individuals, but has no mandatory authority under the Engineers and Geoscientists Act to regulate organizations providing services and/or products involving the practice of professional engineering/geoscience.

All other jurisdictions in Canada except Quebec regulate companies in some way. Does the fact that APEGBC does not have the mandatory authority to regulate companies impact APEGBC's ability to deliver on its primary duty which is "to uphold and protect the public interest respecting the practice of professional engineering and the practice of professional geoscience"?

iii) In June 2015, the BC Ministry of Energy and Mines contacted APEGBC to request a summary of issues related to the potential regulation of organizations that carry out professional engineering and geoscience activities. Government had been exploring this option as a possible outcome of the Mount Polley Mine tailings dam incident and has expressed significant interest in APEGBC's evaluation of this issue.

iv) Results from quality management audits under APEGBC's Organizational Quality Management program have identified the need for engineering/geoscience companies to improve their quality management practices at an organizational level.

In addition formal correspondence was received by APEGBC from ACEC-BC as recently as 2012 expressing their opposition to APEGBC regulating engineering companies. Also in 2016 a few APEGBC members in senior positions with ACEC-BC member firms expressed to APEGBC their opposition to the Association regulating engineering firms.

However given the above referenced recent background and ACEC-BC's (and their predecessor Consulting Engineers of BC) long standing opposition to APEGBC regulating engineering companies ACEC-BC's formal submission dated November 2016 reflects a significant change in their position on this matter. Following is a quote from their submission:

"After careful consideration of the aforementioned issues and potential benefits to both the industry and the interests of the public, ACEC-BC recommends that APEGBC move to regulate engineering and geoscience organizations in British Columbia. One cautionary note is that any new method of regulating organizations should be in conjunction with the existing OQM program, in order to avoid undue red-tape and proliferation of fees and other charges."

The APEGBC Advisory Task Force on Corporate Practice has received the above referenced submission and ACEC-BC has requested the opportunity to present this submission to the Task Force at their next meeting.

1.2 Multijurisdictional Application Agreement

The Agreement to Facilitate Registration of AIT Applicants was signed on May 28, 2016 by the Presidents and CEOs of APEGBC, Engineers Nova Scotia, Engineers PEI and Engineers Yukon. Under the terms of the agreement, an applicant registered in another Canadian province or territory can apply for registration in two or more of the four participating jurisdictions by making one application and paying all applicable fees for the selected jurisdictions. To date 18 applications have been processed by APEGBC under this agreement. The terms of the agreement also allow for future consideration of one

processing (application) fee for multiple applications; and the participating jurisdictions are now discussing moving towards one application fee to be retained by the jurisdiction that receives the multiple application request. Typically if APEGBC is selected by an applicant in a multiple application, APEGBC will act as receiving jurisdiction for the application due to its online capability. A more fulsome analysis of this proposal will be brought to the February Council meeting for consideration.

1.2 Seismic Retrofit Program Update

An update on this initiative is provided in the report on government relations.

2. Association Matters

2.1. Applied Science Technologists and Technicians of BC (ASTTBC)

Since the last report on this subject, ASTTBC has temporarily suspended their certification process for the PTech Designation. This was done to give them time to better align their certification process with Alberta's PTech even though, unlike Alberta, PTechs in BC has right of title only not right of independent practice. ASTTBC is continuing their lobbying efforts with Government to have their Act changed to enable them to grant independent practice rights for PTechs.

APEGBC's appointed members to the ASTTBC/APEGBC Joint Board is maintaining their position as directed by APEGBC Council to insist that the path for ASTTBC PTechs to achieve independent practice rights is to be certified as a Licensee with APEGBC.

It is expected that the appointed members to the Joint Board will be meeting in the near future to discuss and confirm the purpose of the Joint Board.

2.4. Pacific NorthWest Economic Region (PNWER)

Colin Smith, APEGBC's Delegate to PNWER will be attending the Winter meeting in Boise, Idaho. APEGBC is co-sponsoring a reception with APEGS as a means to raise the profile of our two organizations with business leaders and government officials.

3. Internal Operations

3.1. Compliance Statement

APEGBC has met all of its legal obligations. There are no outstanding lawsuits or other liabilities that would materially modify our financial position.

3.2. Space Update

Substantial completion status of the building renovation project has been reached. Over the next few weeks, the upstairs security door and deficiencies will be addressed. Final completion of the project is expected to be in mid-December. The total project cost is forecasted to be below the Council approved budget of $1.5M.

4. Member and Public Affairs

4.1. Media Interactions

BC's seismic preparedness is a recurring theme in media every autumn with the start of the school year and the Great BC Shake Out; however greater interest has been prompted by recent earthquakes in Italy and Japan and the CBC podcast series 'Fault Lines.' A series of articles in the *Vancouver Sun* and *Province* focused on seismic risk and emergency preparedness in BC, and interviewed subject matter experts from APEGBC's Seismic Peer Review Committee, as well as APEGBC's Director of Professional Practice, Standards and Development. APEGBC's support was cited for a proposed plan which would see the federal government provide funding to build resiliency into homes and commercial and municipal buildings.

Earned media included the pick-up of news releases about APEGBC's 2016 award winners and honourary members by the *Canadian Business Journal*, the *Coast Reporter*, and the BC Local News network (Black Press). A news release about APEGBC's newly elected Council was also picked up by the *Canadian Business Journal*.

4.2 Report on Branch Representatives Meeting

On Friday, October 21, 2016 representatives from 14 of the 15 APEGBC branches attended the Fall Branch Representatives Meeting in Victoria, BC. The meeting was chaired by the Branch Representatives Chair, Tomer Curiel, P.Eng. The meeting began with an update on APEGBC Council initiatives. Other association updates included a review of the guidelines for appointing branch representatives to the Nominating Committee and an update on the consultation for corporate regulation. The branches also discussed proposed changes to the Branch Terms of Reference and current progress on their branch goals for 2016/17. Councillor Kathy Tarnai-Lokhorst also provided the group with an update on 30 by 30 initiatives. The meeting was followed by a mix & mingle with Council and positive feedback was received from branch representatives on this opportunity to interact with Council.

4.3 Annual Conference and AGM

APEGBC's 2016 Annual Conference and AGM was held October 20-22, 2016 in Victoria, BC and had attendance of 812 attendees. Following the conference, a survey was sent to delegates requesting their feedback on the event and recommendations for improvement. The feedback of conference participants is a valuable resource that APEGBC staff refer to during the planning process for the next conference.

A total of 104 delegates completed the survey, and some highlights include:

- The top three highlights for attendees were the keynote presentations, professional development sessions and networking.

- For 69.2% of the delegates, professional development was the primary reason for attending the conference.

- 87% of respondents rated the keynote presentations as either excellent or good.

- 84% of respondents rated the networking and social events as either excellent or good.

- 97.1% of respondents rated Victoria as the location for the conference as either excellent or good.

- 96.2% of respondents rated the overall quality of the conference as either excellent or good.

- 90.4% said they would recommend someone else to attend next year's conference.

4.4 Member Engagement Strategy Update

Delivery of Stage 1 of the member engagement strategy approved by Council in June 2017, continues. Communications staff have developed key messages with a clear regulatory focus – these are currently being incorporated into APEGBC's external communications, most notably the association's marketing collateral, publications and support materials for public engagement (scripts, speaking notes, presentations).

Meetings are underway to engage APEGBC's branch executives in order to share a better understanding of members' questions, concerns and awareness of APEGBC's regulatory role under the *Engineers and Geoscientists Act*. Meetings have been held with the executives of the Richmond/Delta, Tri-Cities, West Kootenay, and Vancouver branches, with more planned for the upcoming months. These meetings have been valuable in strengthening the association's connection with its grassroots leadership, and creating a deeper understanding of APEGBC's role and current regulatory challenges.

Date: November 16, 2016

Report to: **Council for Information**

From: Deesh Olychick, Director, Member Services;
Mara Buzgar, Member Services Coordinator
Tim Verigin, Member Services Coordinator

Subject: Branch Engagement Report

Linkage to Strategic Plan: Support potential members in acquiring the competencies required for professional registration. Improve resources and education as well as awareness and access to resources that help members practice to high professional and ethical standards.

Purpose:	To update Council on current Branch engagement
Motion:	No motion required.

Background

Council has identified branches as playing a fundamental role in increasing member engagement. Branches currently support and drive member engagement in several different ways. All branches were asked to provide information updates for this report to Council. Information presented here is based on those branches that provided reports.

Engagement Report for June 30, 2016 to November 8, 2016

We have identified three main areas in which branches support the association through member engagement: Outreach Initiatives, Association and Member Support, and Events and Activities. Branch activities in each of these areas are reported on for the period of time since the last branch engagement report.

Outreach Activities

Elementary and High School Students

During this reporting period APEGBC branches directly engaged 240 elementary and high school students. Outreach activities included the following:

- The Victoria Branch visited two separate schools; Victoria Central Middle School and Colquitz Middle School engaging with a total of 200 students.
- The Richmond/ Delta Branch partnered with the Richmond Public Library to offer a course called Introduction to Electronics. They engaged with 40 students from grades 7 to 12.

University Students

With respect to University engagement, collectively the branches reached 94 students in post-secondary education. Outreach activities included the following:

- The East Kootenay Branch coordinated 3 presentations for a first year class at the College of the Rockies. These presentations reviewed the role of APEGBC and highlighted important engineering and geotechnical issues. In total, the branch directly engaged with 39 students.
- The Central Interior Branch co-hosted a Student Welcome BBQ with UNBC, and connected with 30 students.
- The Victoria Branch partnered with the Division of Engineers and Geoscientists in the Resource Sector (DEGIRS) to invite students from the University of Victoria for a networking event; 25 students attended.

Community Outreach

By engaging with the public and increasing community connections, APEGBC Branches raise the profile of the professions. The Richmond/ Delta branch hosted a five part series at the Richmond Public Library, titled, “Introduction to 3D Design” where 15 participants learned the basic concepts of 3D design, and in the final class they created their designs using a 3D printer. The Tri-City Branch hosted "Dream it, Be it" is a professional career support program for young women, sponsored by Soroptimist International.

Association and Member Support

The branches continue to promote association programs and events as part of their announcements and a rotating slide presentation at their branch events. These programs include the mentoring program, OQM program, and volunteer opportunities.

Branch Governance

During this reporting period, the Northern Branch, Sea-to-Sky Branch, Burnaby/New West Branch, Okanagan Branch, West Kootenay Branch and Fraser Valley Branch had their Annual General Meeting and welcomed new branch chairs. The new branch chairs for 2016/2017 are:

- Anastasia Ledwon, P.Geo. and Rhonda Mellafont, P.Geo., Northern Branch
- Vadim Airiants, P.Eng., Sea-to-Sky Branch
- Niankun Rao, EIT, Burnaby/ New West Branch
- James Barr, P.Geo., Okanagan Branch
- Stefan Humphries, P.Geo., West Kootenay Branch
- Ria Bhagnari, EIT, Fraser Valley Branch

Events and Activities

Branch hosted events are held in almost all branches, and include tours of local projects, and breakfast, lunch or dinner presentations that are eligible for professional development hours.

These events help to build a sense of community amongst members and are also open to members of the public interested in connecting with the professional engineering and geoscience community.

Collectively, out of the nine branches that submitted their member engagement forms to APEGBC for this reporting period, the branches held 37 successful events, which attracted over 1,089 attendees. Some of these events included:

- Tour of the Transportation Safety Board of Canada – Tri-City Branch
- Tour of Kimberley SunMine and Sullivan Underground Mine – West and East Kootenay Branch
- Monthly Networking Night – Central Interior Branch
- Tour of Pacific Western Brewery – Central Interior Branch
- Sustainability Panel Discussion – Vancouver Branch
- Breakfast Seminar: Railway Noise Canada vs. the World – Vancouver Branch
- Asset Management Workshop – Victoria Branch
- Norco Bicycles; A Worldwide Canadian Branch – Sea-to-Sky Branch
- Tour and Introduction to the Geology of the North Shore – Sea-to-Sky Branch
- Social Mixer – Tri-City Branch
- D-Wave Quantum Computer Tour – Burnaby/New West Branch

Upcoming Events

Below is a list of upcoming events; the branches encourage Council to attend these events where possible.

Organizer	Date	Event Type	Description
Victoria Branch	November 29, 2016	Presentation	North Island Hospitals Project: Building Better Healthcare
Central Interior Branch	November 30, 2016	Presentation and AGM	Site C Clean Energy Project, BC Hydro
Tri-City Branch	December 1,	Tour	Tour of Mossom Creek Hatchery

	2016		
Victoria Branch	December 2, 2016	Presentation	Infrastructure for a Low Carbon Planet
Vancouver Branch	December 5, 2016	Breakfast Seminar	Designing for Digital Health; Affective Computing and Regulatory Compliance
East Kootenay Branch	December 6, 2016	AGM and Dinner Presentation	Elk River Alliance Presentation
Vancouver Branch	December 8, 2016	Tour	Tour of Zaber Technologies: Precision Actuation Workshop and Company Tour
Richmond/Delta Branch	December 14, 2016	Tour	Tour of Annacis Island Wastewater Treatment Plant
Sea-to-Sky Branch	December 15, 2016	Dinner Presentation	Carbon Capture

For more Branch Events please visit the Branch Events Calendar

Date: November 15, 2016

Report to: **Council for Information**

From: Russ Kinghorn, P. Eng., FEC

Jeff Holm, P. Eng., FEC

APEGBC Directors to the Board of Engineers Canada

Subject: Engineers Canada Update

Engineers Canada Report on September 2016 Board Meeting

Engineers Canada has published the attached report on the September Board meeting.

Update on Order des Ingénieurs du Québec (OIQ is the regulator of Professional Engineering in Québec)

Kathy Baig, President of OIQ and Engineers Canada Board member, gave a presentation on how it operates now that it is no longer a self-regulating body.

- The OIQ Council still exists with its former makeup
- The Council passes motions as it had before
- Once the motions are passed, they are reviewed by a 3-person “Board of Trustees” which formulates questions for the Council
- The questions return to Council for consideration before they vote again on the motions
- At this point, no decisions have been overturned, however Council must be very careful to accommodate concerns of the Trustees.
- OIQ Council is hoping that they will return to self-regulation with the idea that it may happen in a year or so, however they have been given no indication by government as to the duration of the Board of Trustees nor whether the government has other views of how Professional Engineering will be regulated in the long run.

September 2016 Board Meeting and Annual Meeting of Members Summary

Materials are on the Board Meeting Microsite and Engineers Canada website, as linked in item titles.

Appointments Approved

Connie Parenteau was appointed to the Board's Executive Committee.

David T. Lynch, nominated by APEGA, was approved as an Engineers Canada director.

President's Update

President Chris Roney updated the Board on his attendance at regulators' annual meetings, as well as a number of stakeholder linkages.

CEO Report to the Board

CEO Kim Allen updated the Board on key activities, including: launch of the Infrastructure Resilience Professional certification, launch of the Engineers Canada Mobility Register, launch of an online guidelines catalogue and an online case law catalogue, responses to federal government summer consultations, and updated 30 by 30 numbers which show the national average remaining at 17 per cent.

Big Picture Thinking

The Board and guests discussed societal leadership. Points discussed included: that engineers are not always recognized for how public interest mandates intersect with societal leadership, how can the profession shift from reactive engagement with government (inquiries and commissions) to more active advisors of policy, the importance of contributing within the scope of unique skills and knowledge, how Engineers Canada can position engineers as the leaders where provincial regulators face barriers, and proactively offering solutions to society's problems. A summary of the discussion will soon be available on the Board meeting microsite.

Accreditation Board Report

Wayne MacQuarrie, Chair of the Accreditation Board, presented the AB update. He provided a description of the AB and detailed the work of the AB since the last reporting period.

NCDEAS Report

Greg Naterer, NCDEAS chair, presented the update from the NCDEAS. Key points included a summary of current activities and projects, feedback from the Accreditation Forum, and recommendations for next steps in accreditation.

Accreditation Forum

Wayne MacQuarrie reported on the Accreditation Forum held in August in Toronto. He reported that attendance and engagement was strong. Two documents have since been released from the Forum: Consultant's Report and Book of Proceedings.

Proposed Changes to Accreditation Criteria

The Board passed two motions related to accreditation criteria, as outlined in the Report to the Board on Proposed Criteria Changes:

- Motion 1: Approved proposed "housekeeping" revisions.
- Motion 2: Approved that a program must have a minimum of 1,950 accreditation units (AU) that are at a university level, with a minimum 1545 AU in core subjects and a minimum of 405 AU in complementary subjects.

Presidents' Group Update

Michael Wrinch presented an update to the Board from the Presidents Group. Points discussed included: consistency in mobility, a desire for advanced visibility of financial impact of Engineers Canada projects, onboarding of presidents at Engineers Canada meetings. Engineers Nova Scotia President Chris Zink will take on role as chair of the Presidents Group.

CEO Group Report

Ann English presented an update to the Board. Points of discussion during CEO Group meeting included: review of the CEO Group Terms of Reference, review of the terms of Reference of national officials groups, legal issues impacting the profession and the competency-based assessment project, among other topics.

Matters Impacting the Profession

Kathy Baig presented on OIQ's status as under trusteeship. The decision was made by the Minister of Justice to accelerate the process stemming from the Charbonneau Commission. Trustees are mandated to collaborate with OIQ leadership by observing, reviewing decisions, and providing advice. No timeline on when trusteeship would end, but picture will likely emerge when OIQ's strategic plan is complete.

September 2016 Board Meeting and Annual Meeting of Members Summary

Materials are on the Board Meeting Microsite and Engineers Canada website, as linked in item titles.

Engineers Canada's 30 by 30 Champion

The Board passed a motion appointing Sarah Devereaux as the Board's 30 by 30 champion.

CFES Update

Lucas Brewster, Vice-President of Finance and Administration, presented an update to the Board. He provided a background of CFES, discussed participation with the EIT committee and Accreditation Board, announced the creation of two working groups of CFES: bilingualism and accreditation, announced that CFES has officially adopted the 30 by 30 position, and that they are working to establish self-sufficient engineering competition with international partners.

Qualifications Board Update

Dennis Peters, QB Chair, reported on the work of its committees. Since the last Board meeting, the QB has: held a face-to-face meeting and workshop, completed 2 guidelines, modernized its website presence, adopted a new guideline and model guide review process and approved a new communications strategy.

Open Forum

Part 1: Strategic planning. The purpose and approach to the strategic planning process was presented. The outcomes of the June 2016 Board workshop were discussed. Through a structured process, the Board reviewed over 700 data points, grouped them into themes, refined those themes, then selected the top 6. Between now and December 19, 2016, Board members will be consulting with their members in order to produce a third draft which will be presented at the February 2017 Open Forum. Engineers Canada planning documents can be found at https://engineerscanada.ca/about/our-plans

Part 2: Engineering, Infrastructure and our Changing Climate. A presentation of Engineers Canada's current activities toward adapting to climate change and promoting resilient infrastructure. Background on the PIEVC protocol, as well new initiatives such as the Infrastructure Resilience Professional certification. Audience was asked to consider how two questions: how can regulators help Engineers Canada reach its target audience with its PEIVC and IRP programs, and how can Engineers Canada support regulators in promoting to their membership?

Part 3: Organizational Quality Management. Engineers Canada and APEGBC are in discussions about how the Organizational Quality Management (OQM) program of APEGBC could be expanded nationally. Engineers Canada and APEGBC are seeking input from regulators, and sense of their interest in getting involved.

Next Meeting

Board Meeting: February 27 to March 1, Ottawa, ON.

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From the office of the Chief Executive Officer / Du cabinet du chef de la direction

November 4, 2016

Members of the Professional Engineers and Geoscientists of British Columbia 2016-17 Council

Dear Members of Council,

It was my pleasure to attend APEGBC's 97th Annual General Meeting along with President Chris Roney a few weeks ago. Congratulations on your very successful conference, annual general meeting and awards celebrations. I was also pleased to be able to attend your council meeting on Saturday.

I would like to thank you for the time that you have dedicated and continue to dedicate to serving the engineering profession. Together we help to ensure that engineers continue to safeguard the economy, the environment, and residents of British Columbia.

Engineers Canada (www.engineerscanada.ca) is the national body that unites the engineering regulators and the engineering profession in Canada. The following pages provide some insight into Engineers Canada and the work that we do.

I encourage you to stay in touch with Engineers Canada, and up-to-date with engineering news by:

- Signing up for our daily electronic media report that provides a summary of the day's engineering-related news. Contact communications@engineerscanada.ca to sign up.
- Signing up for our bi-weekly electronic newsletter on subjects of importance to the engineering profession. Subscribe at www.engineerscanada.ca/newsletter.
- Follow @EngineersCanada on social media, including Twitter, LinkedIn, and Facebook.

Please feel free to contact me at any time if you have a question about Engineers Canada, an idea regarding advancing the profession or a suggestion for how we can better service the professional engineers and geoscientists of British Columbia. I can be reached via email: kim.allen@engineerscanada.ca; cell: 613-220-9340; or on Twitter: @KimAllenPEng.

I wish you a successful year on Council.

Yours truly,

Kim Allen, P.Eng. FEC

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Engineers Canada is the national body of the 12 engineering regulators across Canada. Our mandate can be seen as threefold:

> First, we are the national voice of the engineering profession itself. We promote and maintain the interests, honour and integrity of the profession, and help to shape its direction and growth both nationally and internationally.
>
> Secondly, we assist the regulators, including APEGBC, in coordinating their activities and policies; in promoting and maintaining high standards in engineering education and in the profession nationally; and in promoting knowledge of the profession to inspire public confidence. We have been given the privilege of self-regulation. The public has placed its trust in us to carry out this responsibility. Earning and maintaining that public trust is so important and is something that we, as Engineers Canada, are devoted to.
>
> And thirdly, we support the individual engineer with resources and tools to help them succeed in their work and personal lives: we strive to take care of our engineers throughout their careers and beyond.

What are Engineers Canada's assessment fees?

The annual rate of the assessment for all regulators is $10.21/registrant (an individual registered with APEGBC, with the exception of applicants and students) and remains unchanged since 2006. Engineers Canada's 2016 operational expenses total $11.1 million. About 28 percent of the cost of these programs was borne by the above assessment fee.

What is the structure of Engineers Canada Board?

The Engineers Canada Board is comprised of up to 25 directors and five advisors. Directors are elected at the annual meeting. Each regulator may nominate one director. Regulators with more than 20,000 registrants (ON, AB, QC & BC) may nominate one additional director for each additional 20,000 registrants. Professional Engineers and Geoscientists of British Columbia may nominate two directors.

The Executive Committee has seven directors and two advisors. The President, the President-elect and the Past President are all members. The by-law ensures regional representation. Additional directors are added to ensure that Ontario, Quebec and Alberta, Atlantic Canada, Prairies and the West/North regions each have a representative. There is also one director-at-large.

How are APEGBC issues brought forward to Engineers Canada?

Currently, Jeff Holm and Russ Kinghorn are directors from APEGBC. Jeff's three-year term will end in June 2018, while Russ' term ends in June 2019. Russ is currently President-Elect of Engineers Canada, and will serve as our President for the 2017-2018 term. APEGBC CEO and Registrar Ann English is also an Advisor on the Engineers Canada Board and chairs the Board's CEO Group. APEGBC members and staff also serve on Engineers Canada committees, which actively participate in all of the organization's undertakings, decisions, and long-range planning.

What does Engineers Canada do for APEGBC and for the other engineering regulators?

We exist to provide national support and leadership on behalf of the regulators to promote and maintain the integrity, honour, interests and excellence of the profession at a cost that is justified by the results.

Engineers Canada's work and activities are all designed to achieve four Ends that support this purpose:

- Regulatory excellence
- Confidence in the profession
- Sustainability of the profession
- Protection of the engineering terms

Goal Area	Board's Budget Allocations	2016 Budget	Amount ($000s)
E-1 Regulatory Excellence	≥ 40%	58%	$5,735
E-2 Confidence in the Profession	15% - 25%	21%	$2,590
E-3 Sustainability of the Profession	15% - 25%	17%	$2,343
E-4 Protection of the Engineering Terms	≤10%	4%	$432
Total		**100%**	**$11,100**

What is Engineers Canada doing to promote regulatory excellence in the engineering profession?

We work to ensure that a current framework, standards, practices, and systems, as well as a means to effectively transfer knowledge to facilitate regulatory excellence, are available to the regulators. Engineers Canada undertakes a range of activities to achieve this End:

Accreditation Board:

Engineers Canada accredits 279 higher education programs, promoting and encouraging high standards in engineering education, and ensuring that they prepare students to meet the academic requirements for licensure and that they maintain Washington Accord signatory status. The Accreditation Board also plays a key role in international activities by assessing the equivalency of accreditation systems used in other nations relative to the Canadian system, by negotiating international agreements at the educational level, and by monitoring the accreditation systems employed by the engineering bodies that have entered into mutual recognition agreements with Engineers Canada.

Qualifications Board:

Engineers Canada publishes national practice standards and guidelines on the qualifications for registration, the standards of practice and the ethics expected of professional engineers, for adoption by the regulators and for use by licence-holders. For example, the Qualifications Board recently published a white paper on professional practice in software engineering, which differentiates between software development and engineering. APEGBC has encountered success in bringing greater consistency to the distinction between software development and software engineering, and Engineers Canada is happy to have supported those activities with the white paper.

The Qualifications Board also publishes the *Engineers Canada Examination Syllabus*, which describes an examination program for use by the regulators to check an applicant's academic knowledge if they have not graduated from an accredited program, nor from a program that falls under an international mutual recognition agreement.

Mobility:

Engineers Canada makes available and promotes information, systems, and agreements to facilitate mobility for registered engineers. The National Membership Database further enhances the ease of movement of engineers across Canada. The Engineers Canada Mobility Register was recently launched—with the great support and input from APEGBC—and facilitates the registration of Canadian engineers in countries representing over 50 per cent of the world's GDP.

Foreign credential recognition:

Engineers Canada developed the International Institutions and Degrees Database to provide timely information on various degrees and institutions around the world that have been compared to Canadian standards. Engineers Canada has also created the International Engineering Graduate Roadmap to Engineering in Canada (www.newcomers.engineering.ca) to provide a central location for international engineering graduates to access information on entering Canada's engineering profession. The website is used by more international professionals seeking licensure than any other site in Canada.

Framework for regulation:

Engineers Canada developed the Framework for regulation, a set of aspirational elements that form the baseline for engineering regulators. The Framework captures excellent national and international practices; responds to emerging trends and challenges; and facilitates fair practices that are accessible, timely, monitored, transparent, objective, impartial and just. Canadian engineering regulators decide if, when and how to adopt the elements in their jurisdiction.

Self-regulation:

Engineers Canada makes national and international information and trends on self-regulation available to the regulators and clarifies policy and draft legislation to ensure consistency in language in order to maintain a strong, self-regulated profession today and in the future.

Organizational Quality Management:

APEGBC has been a trailblazer when it comes to the Organizational Quality Management (OQM) program, and Engineers Canada is now championing this program at the national level. We're working with APEGBC to bring the program to all provinces and territories to benefit organizations that employ engineers, the individual engineers themselves and the profession itself.

How does Engineers Canada promote confidence in the engineering profession?

Engineers Canada aims to ensure that stakeholders have evidence that engineers meet high standards and practise with competence and integrity, and that their work and self-regulation benefit society. To this end, Engineers Canada undertakes a range of activities to promote this confidence in the profession:

Government relations:

Engineers Canada has a robust government relations program that ensures that timely and relevant national positions and expertise are made available to the federal government and to policy-makers. Engineers Canada regularly meets with members of Parliaments and senior officials from the public service regarding the public interest concerns of the engineering profession.

Public confidence:

Engineers Canada monitors the public confidence and public expectations of the profession and makes this information available to stakeholders.

Raising the profile of the profession:

Engineers Canada works to improve the image of engineering through various activities such as National Engineering Month and participating in Canadian Federation of Engineering Students activities.

Awards and Scholarships:

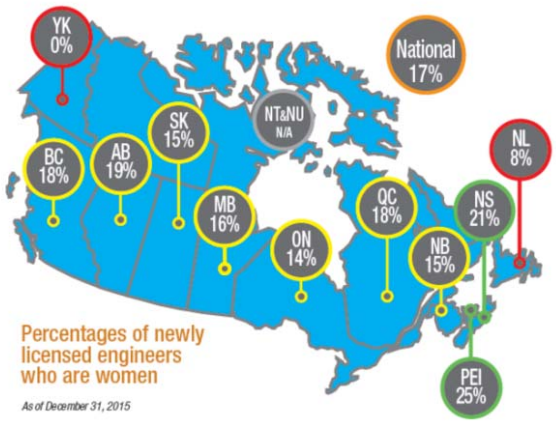
Engineers Canada manages a program of prestigious awards and scholarships, which recognize, honour and publicly celebrate the work of Canada's professional engineers, teams of engineers, engineering projects and engineering students.

What work is Engineers Canada undertaking to ensure the sustainability of the engineering profession in Canada?

Engineers Canada is working to ensure that the engineering profession is sustainable and reflective of Canadian demographics by making sure that engineering is recognized as an attractive profession. It undertakes a range of initiatives in support of this goal:

Diversity in the engineering profession:

Engineers Canada develops programs and resources to increase the diversity of the profession, including women and Indigenous Peoples. For example, Engineers Canada is committed to raising the percentage of newly licensed engineers who are women to 30 percent by the year 2030—this is a key component of Engineers Canada's objective to achieve sustainable membership of the regulators that is reflective of Canadian demographics. We are delighted with the leadership APEGBC and other BC stakeholders have taken in this area. For example, nearly three out of 10 students in UBC's first-year engineering programs are women and UBC has set a goal of 50 per cent female enrolment in their engineering programs by 2020.



Engineers Canada also published "Managing Transitions" in January 2016, a resource guide to assist engineers and geoscientists—and their employers—as they consider taking maternity or parental leave.

Research:

Engineers Canada initiates and executes studies and related communications regarding trends in the engineering profession and makes this information available to policy-makers to use in decision-making. This research also informs Engineers Canada's own programs related to a sustainable and diverse profession. Engineers Canada's regular research reports include the *Final Year Student Exit Report,* the *Labour Market Report,* the *National Membership Report* and the *Enrolment and Degrees Awarded Report.*

In July, Engineers Canada launched EngScape. It presents labour market trends for the Canadian engineering profession. From employment rates and salary, to post-secondary enrolment and immigrant employment, this information is available by province and discipline.

How does Engineers Canada protect the engineering terms?

Engineers Canada works to ensure that the public is not misled by persons improperly using terms, titles, images, and words that are integral to the engineering brand, including in federal corporations and trademarks. In doing so, it promotes an understanding by the public that the protected titles engineer, engineering, professional engineer, consulting engineer, P.Eng. and the French equivalents are used only by individuals and organizations that have been authorized by the regulators to use these titles. Engineers Canada also provides public access to a database of the decisions of the Trademark Opposition Board and the Federal Court related to Engineers Canada matters, and supports the regulators in defending the improper use of engineering terms, titles, images and words in provincial and territorial corporations and trademarks.

What programs and services does Engineers Canada offer to individual engineers?

Engineers Canada uses the collective buying power of 290,000 engineers to provide a competitive suite of insurance, financial, and other programs to support engineers in their professional and personal lives. These include:

Secondary Professional Liability Insurance Program

Professional members of all associations with the exception of PEO and OIQ have the following worldwide coverages for $5.50/member/year. The suit must be brought in Canada.

Coverages

- Whistleblower coverage
- Mentoring coverage
- Libel and slander coverage
- Prior acts coverage
- Pollution coverage
- Copyright/Patent Infringement coverage
- Personal injury coverage
- Estate coverage
- Retirement coverage
- Incidental consulting outside of main employment coverage if fees earned per year are $15,000 or less

Limits

- per member: $250,000 per claim plus defence costs
- aggregate per project: $500,000
- whistleblower coverage: legal advice and loss of income $75,000, with no deductible

Insurance programs:

- Professional Retiree Health and Dental Insurance (Manulife): A new program that offers three choices of coverage levels that pick up when your work benefits end.
- Home and Auto Insurance (TD Insurance): Be part of a program that has been tailored exclusively to the needs of engineers since 1950.
- Term Life and Accident Insurance (Manulife): Join one of the oldest and largest group plans in Canada.
- Health and Dental Care, Disability Income Replacement, and Business Overhead Insurance (Manulife): Get financial protection against sickness and accident so you can continue to provide for your family.
- Critical Illness Insurance (Manulife): Save 10 percent on coverage of $125,000 or more per person.
- Pet Insurance (Petsecure) Get exclusive rates from the #1 recommended provider in Canada.

Professional insurance programs:

- Professional Liability Insurance (Encon): Join a program that has been endorsed by Engineers Canada for more than 45 years.

Financial programs:

- Financial Security Program (Great West Life): Get lower fees and free personal investment guidance and support.
- Bank Manulife One (Manulife): Simplify your banking, reduce your debt and grow your wealth.

Other services:

- Car Rental (Budget): Get low rates and unlimited mileage on business and leisure travel.
- Shipping (UPS): Save between 25 per cent and 84 per cent on shipping services worldwide.

Date: November 15, 2016

Report to: **Council for Information**

From: Gillian Pichler, P.Eng.
Director, Registration

Subject: Update on National Competency-Based Assessment

Linkage to Strategic Plan: Government, Public and Other Stakeholders:

Purpose:	To update Council on the status of National Competency-Based Assessment
Motion:	No motion required.

Background

2010 – 2015

In June 2011 Council approved APEGBC's framework for competency-based assessment of engineering experience which was then implemented through a pilot online reporting tool in January 2012. In 2014, an APEGBC-developed online reporting tool that is fully integrated with APEGBC's Member Relationship Management System was launched and in 2015, reporting experience through competency-based assessment became mandatory for applicants for professional engineer registration.

Over 1,000 professional engineers have been registered by APEGBC through competency-based assessment and there are currently over 6,000 applicants and engineers-in-training building their competency-based experience portfolios on the system in preparation for their professional engineer applications. Competency-based assessment has formed the basis for more streamlined registration process and policies and also for programs such as the Accredited Employer Member-in-Training program.

During the development of the APEGBC framework and system, Engineers Canada formed a Steering Committee in which APEGBC participated, to develop a framework of competencies for engineering experience. In 2013, provincial and territorial engineering regulators were requested by Engineers Canada to approve adopting the Engineers Canada competencies and proposed assessment process as the baseline for national harmonization of the work experience requirement, and to support the progressive implementation of the proposed solution by Engineers Canada. Given that APEGBC's system had been successfully implemented, the Council of the day resolved:

that APEGBC continue with its own competency-based assessment framework and system as approved by Council, including the APEGBC online tool for submission, validation and assessment of experience; and that APEGBC also supports in principle the further development of the Engineers Canada competency system including training tools for participants and an online tool for submission, validation and assessment of applicants.

In February 2015, Council resolved:

That Council supports the concept of sharing APEGBC developed online competency IT systems with others. Council directs staff to develop a business proposal based on relevant legal and fiscal considerations specific to online competency IT systems.

2016

Engineers Canada has entered into a funding agreement with ESDC (Employment and Social Development Canada) to develop and implement an online tool necessary for the competency-based assessment of engineering work experience necessary for licensure and to develop and implement an online assessor training tool and learning management system.

Engineers Canada has indicated that they will adopt the APEGBC technology as the technical foundation for competency-based assessment and has both allocated Engineers Canada funds and funding from its agreement with ESDC to make this available nationally. Engineers Canada's role is proposed as national marketing, change management, training and adoption support. They have also indicated that they are committed to provide the funding to make the APEGBC technology ready for national use. APEGBC's role would be to host and maintain the tool on an on-going basis and to host a national users' group to support continuous development and enhancement of the tool.

In April 2016, in support of this anticipated role for APEGBC, Council approved *that staff on behalf of APEGBC establish the organizational and corporate structure needed and, if required, create an appropriate sub-entity (subsidiary), to offer APEGBC's Competency Based Framework and/or Online Assessment Tool as an Internet accessible Software-as-a-Service (SaaS) on a cost recovery basis.*

Discussion (Update)

- Since April, discussions have been ongoing with Engineers Canada staff, the CEO Group and the National Admissions Officials Group with respect to national implementation of the APEGBC solution
- In October, APEGBC and Engineers Canada staff project team met twice to discuss the project plan to facilitate implementation of the APEGBC solution, the first stage of which would be to set up three regulators to pilot the APEGBC system to support familiarization with the system and definition of future requirements. The project would also include development of a Governance Structure (a User and Business Model Group), the national Competency-Based Assessment Program and a Competency-Based Assessment Adoption Process
- Three regulators have expressed interest in piloting the APEGBC competency-based assessment system and are currently discussing pilot participation with their boards and committees responsible for endorsing their participation. APEGBC staff are meeting with representatives of these regulators and Engineers Canada staff on November 21st to further discuss pilot implementation.
- APEGBC has developed a multi-staged web-based technology approach to support the initial implementation of a pilot using the current APEGBC framework, system and training modules through the eventual transition of regulators to managing their own assessments with look and feel specific to each participating regulator; and
- Engineers Canada is consulting with APEGBC and other regulators regarding the methodology needed to develop a set of harmonized competencies for use by regulators across Canada; and

- Discussions are ongoing with Engineers Canada with respect to clarification of the roles of APEGBC and Engineers Canada for the project, specifically with respect to project management and financial support.

Council will be updated on the progress of the project as developments arise.

Date: November 14, 2016

Report to: **Council for Information**

From: Jason Ong
Manager, Exams, Geoscience Registration and Member-in-Training Program

Subject: Status Update on Geoscientists Canada's Competency Profile for Professional Geoscientists at Entry to Practice

Linkage to the Strategic Plan: Members and Future Members

Purpose:	To update Council regarding the recent discussion and planning by the Canadian Geoscience Standards Board on the deployment of Geoscientist Canada's Competency Profile for Professional Geoscientists at Entry to Practice.
Motion:	No motion required.

Purpose

To update Council regarding the recent discussion and planning by the Canadian Geoscience Standards Board (CGSB) on the deployment of Geoscientists Canada's Competency Profile for Professional Geoscientists at Entry to Practice ('the Competency Profile').

Background

In November 2014, Council passed a motion that the Geoscience Competency Profile be adopted in principle as the foundational document that describes entry-to-practice competency for professional geoscientists.

APEGBC members and staff were consulted during the development of the profile, serving as subject matter experts, as members of the CGSB, as members of the Admissions Support Tool (AST) project team; also participating in a consultation webinar, survey and workshop. APEGBC's Geoscience and Registration Committees have approved adoption in principle of the profile

Update

The CGSB met in Toronto on October 15, 2016. An update was provided regarding the request for funding to Economic and Social Development Canada (ESDC). ESDC has indicated that the proposal has undergone a preliminary review and that it would potentially be able to support only two out of the three project components.

- *Component 1 – To map the Competency Profile to the Geoscience Knowledge and Experience Requirements for Professional Registration in Canada (GKE)*
- *Component 2 – To identify competency-based assessment tools that might be developed*
- *Component 3 – To develop an on-line self-assessment tool for all prospective applicants*

ESDC has indicated that it might be able to support Components 2 and 3. It does not feel that Component 1 provides value to their primary objective of foreign qualifications recognition.

The CGSB discussed this new development and suggested changes to the AST proposal for resubmission to ESDC. It was decided that the mapping exercise for Component 1 would be valuable, but that it could be undertaken internally within the CGSB. A sub-committee of CGSB representatives has been formed to initiate a preliminary mapping of the *Competency Profile for Geoscientists at Entry to Practice* with the *Geoscience Knowledge and Experience Guideline*.

APEGBC's current Competency Experience Reporting System for engineering was highlighted and referenced during the discussion of *Component 3 – To develop an on-line self-assessment tool for all prospective applicants*. There was general interest in seeing what the geoscience competencies would look like in the APEGBC system. Other associations that were present also updated the CGSB regarding the potential adoption of APEGBC's competency system for engineering.

The CGSB will meet next in March 2017 where further updates will be presented regarding the funding proposal with ESDC and the initial mapping exercise.

Date: November 10, 2016

Report to: **Council for Information**

From: Taymaz Rastin
Staff Lawyer, Regulatory Affairs

Subject: Enforcement Report, July 1, 2016 to October 31, 2016

Linkage to Strategic Plan: Develop strategies for protection from noncompliant members and unregistered practitioners

Purpose:	This report is for updating Council on enforcement activities undertaken by the Legislation, Ethics & Compliance Department ("LEC") from July 1, 2016 to October 31, 2016 (the "Reporting Period").
Motion:	No motion required.

Statistics

A summary of the file openings and closures during the Reporting Period is as follows:

Files Carried Forward from prior to the Reporting Period	28
Files Opened during the Reporting Period	20
Files Closed during the Reporting Period	14
Files Remaining Open at the end of Reporting Period	34

Summary of Activities

During the Reporting Period, the highlights of LEC's enforcement activities have been as follows:

- Negotiated a public Settlement Agreement between APEGBC and Cerner Canada ULC to ensure Cerner's compliance with the *Engineers and Geoscientist Act* (the "Act") in its provision of software solutions in British Columbia, specifically in relation to the "iHealth" electronic health record system under a contract with the Vancouver Island Health Authority. The Settlement Agreement has been published on APEGBC's website: https://www.apeg.bc.ca/getmedia/303395f8-b9d9-4a10-aa91-2a62867b040b/Settlement-Cerner-APEGBC.pdf.aspx

- Engaged in discussions with representatives from the BC Technology Industry Association, and the provincial government, on the topic of APEGBC's regulation of software engineering in British Columbia.

- Engaged a shipyard in British Columbia regarding the unauthorized practices and use of engineering titles by a group of the shipyard's employees.

- Negotiated the settlement of the matter of the unauthorized use of engineering titles by four employees of a large mining company based in British Columbia. As part of the settlement, three of those employees have applied for registration with APEGBC, and in the meantime they are not using engineering titles and they are each working under the direct supervision of professional engineers registered by APEGBC. The fourth employee has now been assigned a non-engineering title and is not engaging in the practice of professional engineering.

Enforcement

LEC's "enforcement" activities mainly refer to steps undertaken (pursuant to sections 22, 23, and 27 of the Act) to stop unauthorized practices of professional engineering or geoscience by individuals, corporations or other legal entities. An enforcement file is opened when LEC receives a complaint about a case of unauthorized practice, or if APEGBC staff suspect a case of unauthorized practice that requires further investigation.

Historically, only a small portion of enforcement files have ultimately required Court action for resolution, because the vast majority of enforcement targets agree to bring themselves into compliance following the communication of demands from LEC. Compliance is typically achieved either by the target ceasing to engage in prohibited practices, or by the target taking steps to obtain licensure from APEGBC.

LEC follows up on each enforcement file until the resolution of the case. However, the length of time that each file may remain open will vary, depending on the following factors:

- The responsiveness and cooperation of the enforcement target.

- The complexity of the case and length of time required for LEC's investigation.

- The length of monitoring required after the enforcement target agrees to come into compliance with the Act.

Date: November 10, 2016

Report to: **Council for Information**

From: Paul Adams, P. Eng., FEC, Chair of the Discipline Committee
Neil Nyberg, P. Eng., FEC, Chair of the Investigation Committee

Subject: Investigation & Discipline Status Report

Linkage to Strategic Plan: Develop strategies for protection from non-compliant members and unregistered practitioners.

Purpose:	Investigation & Discipline status report for the period ending October 31, 2016
Motion:	None

DISCIPLINE FILES FOR THE PERIOD JULY 1, 2016 TO OCTOBER 31, 2016.

Re: 2014-2015 Files

Patrick Triggs, P. Eng: A Notice of Inquiry was issued to Mr. Triggs relating to a flood hazard assessment report he authored. In lieu of proceeding to a disciplinary inquiry, Mr. Triggs agreed to a Consent Order dated September 30, 2016. In the Consent Order, Mr. Triggs admitted that he demonstrated unprofessional conduct by breaching principles 1 and 2 of the *Code of Ethics.* Mr. Triggs agreed to:

1. a three month suspension of his APEGBC membership;
2. pay $3,000 in costs; and
3. refrain from preparing flood hazard assessment reports, providing professional advice or services relating to flood hazards and practicing in the disciplines of hydrogeology and hydrology.

Re: 2015-2016 Files

Charles Shen, P. Eng: A Notice of Inquiry was issued to Mr. Shen. In lieu of proceeding to a disciplinary inquiry, Mr. Shen agreed to a Consent Order dated August 19, 2016. In the Consent Order, Mr. Shen admitted that he breached section 20(9) of the *Engineers and*

Geoscientists Act by affixing his signature and his professional engineer's seal on engineering documents in circumstances in which he knew or ought to have known that those documents had not been prepared by him or under his direct supervision. As part of the Consent Order, Mr. Shen agreed to:

1. a one month suspension of his APEGBC membership starting from August 19, 2016;
2. take the APEGBC Law and Ethics Seminar by January 31, 2017; and
3. pass the APEGBC Professional Practice Examination by January 31, 2017.

Neil Nyberg, P.Eng.
Chair, Investigation Committee

Paul Adams, P.Eng.
Chair, Discipline Committee

Investigation and Discipline File Summary July 1, 2016 to October 31, 2016

1. Statistics

Re: 2015-2016 Files: For the fiscal year between July 1, 2015 to June 30, 2016, APEGBC opened 87 investigation files and 5 files where we were investigating on behalf of the Registration Committee.

Re: 2016-2017 Files: So far this fiscal year between July 1, 2016 to October 31, 2016, APEGBC opened 21 investigation files and we are conducting 1 investigation for the Registration Committee.

Investigation Files :	
Total open investigation files carried forward as of June 30, 2016 :	93
New Investigation Files Opened between July 1, 2016 to October 31, 2016:	21

New Files opened to assist the Registration Committee between July 1, 2016 to October 31, 2016: (*Note, this is a new category of classification)	1
Files Closed between July 1, 2016 to October 31, 2016:	14
Investigation Files sent to Discipline between July 1, 2016 to October 31, 2016:	4
Total Investigation Files Open at October 31, 2016:	97
Discipline Files:	
Open discipline files carried forward as of June 30, 2016:	4
Files received from Investigation Committee (see above)	5
Discipline Files Closed between July 1, 2016 and October 31, 2016:	2
Total Discipline Files Open at end of October 31, 2016:	6

New Files: The following is a breakdown of the categories of the 22 new complaints. The categories are approximate only and are not necessarily reflective as to the issues that the Investigation Committee may isolate on its review of the complaints:

Structural – 4
Civil – 4
Geotechnical – 3
Mechanical – 2
Use of Seal – 2
Mining – 2
Sewerage – 2
Electrical – 1
Fire Suppression – 1
Conduct Matters (not professional competency) – 1

2. Outcomes between July 1, 2016 and October 31, 2016:

Staff	Files closed by Registrar	7
	Files referred to Practice Review Committee by Registrar	0
	Files closed by Designated Reviewer	2
	Assistance to Registration Committee completed	2
Total closed during Intake Phase		11

Investigation Committee	Files closed by Investigation Committee	3
	Files referred to Practice Review Committee by Investigation Committee	0
Total investigation files closed		3

Discipline Committee	Notice of Inquiry proven at Inquiry	0
	Notice of Inquiry not proven at Inquiry	0
	Consent Order accepted by member	2
	Other (Consent Dismissal Order)	0
Total discipline files closed		2

Date: November 14, 2016

Report to: **Council for Information**

From: Melinda Lau
Acting Director, Communications and Stakeholder Engagement

Subject: Corporate Engagement Update

Linkage to Strategic Plan: Goal 2: Members Employers' and Clients

Purpose:	To update Council on current corporate engagement initiatives.
Motion:	No motion required.

Background

The current Corporate Engagement Strategy focuses efforts on three key priorities. They are:

1. Involve employers in improving the effectiveness of and participation in APEGBC programs.

2. Demonstrate how APEGBC and its members provide technical, professional and ethical value to employers and clients.

3. Develop strategies for protection from non-compliant and unregistered practitioners.

Current Activities

Priority 1: Involve employers in improving the effectiveness of and participation in APEGBC programs.

Corporate Practice Initiative

The Advisory Task Force on Corporate Practice launched the second phase of consultation on corporate practice and the regulation of organizations practising engineering or geoscience with the release of a comprehensive discussion paper on September 26. The discussion paper provides more detailed information on possible regulatory or non-regulatory models of corporate practice and is intended to inform members and stakeholders on the subject and spur focused input.

The discussion paper release was followed by a live webcast on October 5th, which was recorded and made available on the website (apeg.bc.ca/corporatepractice/). A second stakeholder survey was launched October 4th and will remain open until November 30th. APEGBC members were contacted directly through email with information on these and other consultation opportunities. Consultation memos have now been circulated to key stakeholder groups, seeking input on this topic, and presentations at branches around the province are currently underway.

Over the course of the winter, the task force will be reviewing stakeholder input in preparation for formulating a recommendation to Council in the spring. During this time, a summary of stakeholder consultation results will be made available to members.

Organizational Quality Management Program

The OQM Program has now reached a total of 463 organizations that have registered to become OQM certified and a total of 213 that have achieved certification. Since initiation in the fall of 2012, 215 paper audits have been carried out, 54 office audits have been completed and 40 OQM training sessions have been delivered.

The OQM national pilot program has almost completed phase one, having issued its first certification to Roney Engineering Ltd., a structural firm operation in Kingston Ontario, and a second firm from Nova Scotia having received support utilizing OQM Launch Assist via Skype. This second firm is now preparing their application package.

The OQM national pilot program is starting phase two. The goal of phase two is to issue certification to 12 firms outside of BC. Firms for phase two will be selected from organizations who participated in the OQM training session held in Ottawa on July 5, 2016, and organizations with OQM certification in BC that have offices in other provinces.

Sponsorships

APEGBC provides industry support for events and activities through sponsorships. Each opportunity is carefully evaluated for connection to the association's strategic goals and programs, the value it provides, and its return on investment. The following sponsorships and event participation occurred this reporting period or are upcoming:

- November 12, 2016: Internationally Trained Professionals Networking Fair
- November 16, 2016: ASTTBC Technology Awards
- November 16-19, 2016 – Pacific Northwest Economic Region Economic Leadership Forum
- November 16-23, 2016: Inspiring Women Among Us
- November 19, 2016: ASTTBC Technology Awards and Recognition Celebration
- January 23-26, 2017: AME BC Mineral Exploration Round-up

- January 31-February 2, 2017: Premier's Natural Resources Forum.

Accredited Employer Member-in-Training Program

The Accredited Employer Member-in-Training Program has expanded the number of employers participating in the program pilot. As of November 2016, eight employers with a combined 73 EITs have been granted provisional accreditation; and another three companies with 42 EITs have formally expressed interest in participating. The program pilot is comfortably on target to meet its FY 2017 goal of 100 EITs across 10 employers.

The program involves APEGBC's partnering with employers who foster environments where EITs can easily meet the competencies required for their P.Eng. licence. APEGBC staff provides detailed training on current registration requirements directly to the MITs, supervisors and those from within the firms that have been nominated as registration volunteers to serve on MIT Review Panels. It allows accredited employers to partner with APEGBC to ensure that their EITs have met the competencies for licensure and to recommend them to APEGBC, making them eligible for expedited assessment. To date, the program pilot has produced five EIT 'graduates' that have been granted their P.Eng. licences. All five were reviewed and approved for registration in a turnaround time of 28 days or less.

Working in Canada Seminar

The development of online the Working in Canada Seminar, which teaches the four competencies required for practice in a Canadian Environment, is complete and the project has entered the review stage with over 60 professional engineers, subject matter experts, regulator staff and volunteers, and applicants from across Canada participating. The seminar was presented to the Engineers Canada Qualifications Board in September and a focus group has been held with the APEGA Board of Examiners. The seminar can be viewed online: http://experienceincanada.com/working-in-canada-seminar-pilot/.

Status of Priority 1: In progress.

Priority 2: Demonstrate how APEGBC and its members provide technical, professional and ethical value to employers and clients.

Professional Practice Advice

As a result of entries made into the Professional Practice Advice Tracking Tool in July 11, new FAQs (numbers 6 to 16) were added to the APEGBC website page "Professional Practice FAQ."

Professional Practice Guidelines

APEGBC professional practice guidelines create a shared level of expectation among stakeholders regarding the carrying out of particular professional activities within the practice of professional engineering and/or geoscience

On November 10, 2016, the APEGBC Professional Practice Committee recommended that Council approve revisions to the *APEGBC Professional Practice Guidelines – Legislated Dam*

Safety Reviews in BC in order to address the role of the Engineer of Record as it relates to dams in BC.

Status of Priority 2: In progress.

Priority 3: Develop strategies for protection from non-compliant and unregistered practitioners.

An enforcement outreach report has been tabled as a separate item at this meeting.

Status of Priority 3: In progress.

Questions regarding specific activities documented in this report can be addressed to the staff member involved in the activity. Questions of a general nature can be addressed to Melinda Lau, Acting Director of Communications and Stakeholder Engagement.

Date: November 10, 2016

Report to: **Council for Information**

From: Ann English, P.Eng.
Chief Executive Officer & Registrar

Subject: Council Road Map 2016/2017

Linkage to Strategic Plan: Effective governance and resources that enable and guide APEGBC's operations

Purpose:	To provide Council with the current status of the actionable items listed on the Council Road Map for 2016-2017.
Motion:	No motion required.

Background

The attached document summarizes expected agenda items that are planned to be brought forward to Council during the 2016-17 Council year. The items are aligned with the Strategic Plan and will help Council see the progress on elements of the Plan. This road map is not exclusive and additional items may be added as required throughout the year but will serve as a focus for this year's meetings.

APEGBC Council Road Map for 2016-2017

	HIGHLIGHTS	November 25 (Council Mtg)	February 9 (Planning Session)	February 10 (Council Mtg)	April 28 (Council Mtg)	June 16 (Council Mtg)	September 8 (Council Mtg)	October 19-21 (Annual Conf & AGM)
Members & Future Members	BRANCHES, DIVISIONS & SOCIETIES REPORTS	Report of the October 2016 Branch Rep Meeting Branch Engagement Rpt			Branch Engagement Rpt		APEG Foundation AGM and Benevolent Fund AGM Branch Engagement Rpt	
	IMPROVING MEMBER SUPPORT & BRAND		Member Engagement Rpt	Brand Development Update	Report on Eng.L. Title Research		Public Opinion Survey Member Engagement Strategy Update	
	ENHANCING REGISTRATION PROCESSES	Report on APEGBC's Role in Geoscience Competency Assessment		Report/Proposal Bridge P.Tech. to Eng.L. Enhanced MIT Program Policy	Fairness Panel Annual Rpt	Canadian Environment Experience Alternatives Report, Working in Canada Seminar - Policy and Implementation Approval	Annual Update on Eng.L. to P.Eng. Bridging	
Members, Employers, etc.	EMPLOYER ENGAGEMENT			Corporate Engagement Rpt Update on OQM Program	Update on OQM Program Approve Accredited Employer Training Program from Pilot to Permanent			
Government, Public & Other Stakeholders	INCREASING PUBLIC CONFIDENCE			Coporate Practice Task Force Rpt Update from CPD Committee		Approval of Award Nominations	Year End Rpts on (1) Investigation and Discipline and (2) Enforcement	
	ACADEMIC OUTREACH			Visiting Dean (SFU new Dean appointed in January)			Visiting Dean (UBC)	
	ENGINEERS CANADA AND GEOSCIENTISTS CANADA	Directors Rpt Update & Prospectus for approval re: National Competency-Based Assessment		Directors Rpt	Directors Rpt	Directors Rpt		
Enabling Goal	STRATEGIC PLAN CYCLE AND MONITORING ACTIVITIES		Prioritization of Strategic Plan Initiatives KPI Progress Update for 2016/2017		Approval of Strategic Plan Initiatives		AGM Rules Strategic Plan and KPI Update	
	LEGISLATION CHANGES AND BYLAW CYCLE				Approval of Registration Hearings Committee Bylaw *Gov Comm Rpt on possible Revisions to Bylaws and Procedures re Delegation to Comms (tentative)*	*Draft Bylaw changes w/ Consultation Plan (tentative)*		
	IMPROVING DIVERSITY			Update on Diversity Initiatives			Update on Volunteer Management Activities	
	EFFECTIVE GOVERNANCE	Council Governance Training; Approval of Nominating Committee Appointees; AGM Motion Referral		Calendar 2016 Registration Admissions Report	Election Policy Approval		Council Evaluation Fiscal 2017 Registration Admissions Report	Appointment of Councillors to Committees
	FINANCIAL OVERSIGHT	Quarterly Financial Report / Budget Guideline Approval		Quarterly Financial Report	Quarterly Financial Report/ Budget approval		Audited Financial Statements / Year End Review	Approval of Auditors

Activities Completed	
Activities Behind Schedule (by end of September)	
New Item	Items Advanced

Date: November 16, 2017

Report to: **Council for Information**

From: Ann English, P.Eng.
Chief Executive Officer & Registrar

Subject: Council Attendance Summary

Linkage to Strategic Plan: Effective governance and resources that enable and guide APEGBC's operations

Purpose:	To inform Council on the Council Attendance Summary
Motion:	No motion required

Background

The Council Attendance Summary is used to track individual Councillor attendance at the Council meetings and other related Committee meetings that Councillors are a part of (e.g. the Executive Committee, the Governance Committee, the Registration Committee, etc.). Each Councillor is assigned a column which is regularly updated. Presently the table only shows the Council meetings, Executive Committee meetings, and a few other events; the table will be updated as the dates of the other Committees are determined.

At the end of the Council year, each Councillor's column will be tallied and a percentage applied. The intent in curating this summary is to provide information that will assist with future correspondence relating to things such as the election; this will enable staff to display the high level of dedication that is required of candidates. The Council Attendance Summary will also provide a clear visual of the amount of meetings that the average Councillor is required to attend and how many meetings each Committee holds.

Councillor Meeting Summary - 2016/2017

	Bob Stewart	Dr. Ed Casas, P.Eng.	Dr. Mike Wrinch, P.Eng., FEC, FGC	Suky Cheema, CA, CPA (from)	David Wells	Ken Laloge, CPA, CA, TEP	Kathy Tarnai-Lokhorst, P.Eng., FEC	Brock Nanson, P.Eng.	Caroline Andrewes, P.Eng.	Larry Spence, P.Eng.	Susan Hayes, P.Eng.	Ross Rettie, P.Eng., FEC	Cassandra Hall, P.Geo., P.Eng.	Richard Farbridge, P.Eng.	Scott Martin, P.Eng.	Chris Moser, P.Eng.	John Turner, P.Ag.
Oct 22, 2016 (Inaugural Council)	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nov 9, 2016 (Orientation)	✓	✓	✓					✓		✓	✓	✓					
Nov 16, 2016 (Exec Comm)	✓	✓	✓			✓	✓										
Nov 16, 2016 (Gov Comm)			✓						✓					✓		✓	✓
Nov 22, 2016 (Orientation for New GA's)																	
Nov 24, 2016 (New Council AG Walk-Thru)																	
Nov 25, 2016 (Council)																	
Dec 7, 2016 (Exec Comm)																	
Feb 9, 2017 (Planning Session)																	
Feb 10, 2017 (Council)																	
Feb 23, 2017 (Exec Comm)																	
Feb 29 - Mar 1, 2017 (Govt Receptions)																	
Mar 16, 2017 (Exec Comm)																	
Mar 29, 2017 (Exec Comm)																	
Apr 28, 2017 (Council)																	
May 12, 2017 (Industry Breakfast)																	
May 29, 2017 (Exec Comm)																	
June 16, 2017 (Council)																	
Aug 9, 2017 (Exec Comm)																	
Aug 28, 2017 (Exec Comm)																	
Sept 8, 2017 (Council)																	
Percentage of Attendance																	

Victoria

☐ **Attendance Required**

■ **Attendance Not Required**

/// **Meeting Cancelled**

(as at November 16, 2016)

Date: November 8, 2016

Report to: **Council for Decision**

From: Deesh Olychick
Director, Member Services

Subject: APEGBC Election & Nomination Processes

Linkage to Strategic Plan: Effective governance and resources that enable and guide APEGBC's operations

Purpose:	To inform Council of the election process review underway and to request a Task Force be created to review the nomination processes.
Motion:	That Council approve the creation of a Task Force to review the nomination processes and direct staff to create a Terms of Reference for the Task Force.

Background

The *Engineers and Geoscientists Act*, Bylaws and Election Policy outline the policy and procedures for the conduct of the Council election. The Registrar serves as the Chief Electoral Officer and is responsible for the conduct of the election. Each year, the election policy and procedures are reviewed and improvements to the Election Policy are brought forward to Council for consideration.

Discussion

Over the course of this year's review of the election process, there are items noted for improvement. Many of these items will be further discussed with the Governance Committee and brought forward for Council decision in early 2017. These include operational improvements which are covered in the Election Policy.

There were also other items identified that could benefit from a more thorough review by way of a Task Force. Some of these items include:

- **Council Experience Requirement for VP and President (those nominated by the Nominating Committee)**
  Bylaw 3 (b) states that the nominating committee requirement for presidential candidates is 2 full years as a Councillor prior to the date of taking office and, in the case of vice president, one full year as a Councillor prior to the date of taking office, provided that in each case such members are available. The nomination by 25 members does not have this same Council experience requirement. Consideration should be given as to whether the experience requirement should be the same for both nomination processes, e.g., should the experience requirement be removed from the nominating committee process

or be added to the nomination by 25 members? A review of these criteria is suggested. Any change in this regard would require a bylaw change.

- **APEGA Nomination Process**
  The Association of Professional Engineers and Geoscientists of Alberta (APEGA) recently made changes to their election process which involved a bylaw change that was approved by their members at their 2015 annual general meeting. The new process requires all candidates, those solicited by the nominating committee and those nominated by 25 members to be submitted to the Registrar by the same date. The new process also requires all candidates to be reviewed by the nominating committee, with the committee endorsing those candidates best suited based on their skills criteria. A review of the new APEGA process and benchmarking of other organizations is suggested. A change such as this would require a bylaw change.

The Nominating Committee has also discussed the nomination and process for nomination by 25 members and requested that these processes be reviewed. At their October 13, 2016 meeting, the Nominating Committee passed the following motion:

> **MOTION:** That the Committee recommends to Council that the nomination, and self-nomination process be reviewed through the Governance Committee as it has not been reviewed in several years. This should include benchmarking of other organizations. CARRIED.

It is recommended that a Task Force be created to review the nomination and nomination by 25 member process.

Recommendation

It is recommended that Council approve the creation of a Task Force to review the nomination processes and that staff be directed to create a Terms of Reference for the Task Force, which would be routed through the Governance Committee and Council for approval.

Motion: That Council approve the creation of a Task Force to review the nomination processes and direct staff to create a Terms of Reference for the Task Force.

Date: August 29, 2016

Report to: **Council for Decision**

From: Gillian Pichler, P.Eng., Director, Registration

Subject: Renewal of Memorandum of Agreement with the Iranian Engineers of BC Association (IEBCA)

Linkage to Strategic Plan:
Goal 1: Members and Prospective Members
Goal 2: Members' Employers and Clients
Goal 3: Government, Public and Other Stakeholders
Goal 4: Enabling Goal

Purpose:	To renew the Memorandum of Agreement with IEBCA
Motion:	That Council approve the renewal of the Memorandum of Agreement with IEBCA (the MOA) and that the President be authorized to execute the MOA on behalf of APEGBC.

Background

On April 18, 2013, APEGBC renewed its Memorandum of Agreement (MOA) with the Iranian Engineers of BC Association (IEBCA); an agreement that had originally been entered into in February 2009. IEBCA is an organization that serves engineers with an Iranian background working or residing in British Columbia, Canada by providing networking, and assistance (professional development, job search, career counselling). The MOA calls for the agreement to be reviewed every three years.

IEBCA was the third of three engineering organizations to enter into an MOA with APEGBC; the others being the Society of Internationally Trained Engineers of BC (SITE BC) in 2004 and the Bangladeshi Engineers and Applied Scientists of BC (BEASBC) in 2007. The three agreements incorporate standardized wording as the organizations have similar goals and a similar relationship with APEGBC.

At a corporate level, APEGBC supports IEBCA's objectives and the MOA provides direct linkage between our organizations and the means to collaborate in areas of mutual interest and for APEGBC address any potential concerns about the group and its activities.

Discussion

The agreement has been working well over the past three years. IEBCA has suggested that additional wording be added to the agreement to expand on the types of activities and cooperation that it may enter into with APEGBC from time to time. The general terms of the

agreement set out the common goals of the two organizations and incorporate, “a commitment by APEGBC and IEBCA to work in good faith to support each other's goals and mandates. “

Staff has recommended to IEBCA and is recommending to Council that the agreement be renewed ‘as is’, as the requested additions provide detail on membership and activities that align with the current terms of the agreement and are of a more operational nature.

Recommendation

That Council approve the renewal of the Memorandum of Agreement with IEBCA (the MOA) and that the President be authorized to execute the MOA on behalf of APEGBC.

Appendix A – Suggested Changes by IEBCA to Memorandum of Agreement

Appendix B - APEGBC – IEBCA MOU Agreement for Renewal with Recommended Original Wording

Date: November 10, 2016

Report to: **Council for Information**

From: Harshan Radhakrishnan, P.Eng.,
Practice Advisor, Professional Practice Standards and Development

Subject: Presentation to the Federal Expert Panel Reviewing the Canadian Environmental Assessment Processes

Linkage to Strategic Plan: Government, Public and Other Stakeholders: Enhance public confidence in our members through leadership in regulatory, engineering and geoscience best practices

Purpose:	Provide Council with information about an upcoming presentation APEGBC will be making to the Federal Expert Panel reviewing the Environmental Assessment Processes.
Motion:	No motion required.

Background

In response to the announcement of the Government of Canada's mandate to review the federal environmental assessment processes and in particular, in response to the request to provide feedback on the draft Terms of Reference established for the Expert Panel tasked with the review of the federal environmental processes, comments were provided in July this year from the Association prepared with input from the APEGBC's Climate Change Advisory Group, Sustainability Committee and the Division of Environmental Professionals. In response to the written feedback, APEGBC has been invited to participate in engaging with the Federal Expert Panel during their in-person engagement sessions. A presentation based on the comments already provided to the Panel will be provided for the 12th of December engagement session in Vancouver to shape the Panel's recommendations to the Minister of Environment and Climate Change.

Discussion

APEGBC's established position on climate change commits the association to raising awareness about the potential impacts of the changing climate as they relate to professional engineering and geoscience practice. In alignment with APEGBC's 2014-17 strategic plan which intends that governments and other stakeholders look to APEGBC for guidance and leadership, APEGBC has taken an active role in commenting on legislation, regulations and guidelines from these jurisdictions that impact the practice of its professionals.

Recent efforts include commenting on Environment and Climate Change Canada's (ECCC) proposed methodology for estimating the upstream greenhouse gas (GHG) emissions associated with major oil and gas projects undergoing federal environmental assessments, providing feedback on Engineers Canada's draft National Guideline on Sustainable

Development and Environmental Stewardship for Professional Engineers and providing feedback on the BC Climate Leadership Plan.

The July response on the draft Terms of Reference for the Expert Panel has been prepared with input from APEGBC's Climate Change Advisory Group, Sustainability Committee and the Division of Environmental Professionals. These groups include professionals who are directly or indirectly involved in the environmental assessment processes and whose professional practice could be influenced by the changes to the Environmental Assessment Processes (EAP). The following were some of the salient points in the feedback provided to the Expert Panel on the review of the EAP which will be shared during the ten-minute presentation to the Expert Panel on December 12th:

- Public perception that compliance with existing regulations or permits is inadequate should be a focus. To address this the EAP should:
    - specifically address the issues of compliance and enforcement ensuring that adequate resources are available, and
    - include mechanisms and resources to ensure that decommissioning and restoration is consistently completed.
- Cumulative environmental effects must be accounted for, both geographically and temporally. This accounting should include consideration of the impacts from the project's related activities. To the extent reasonably possible, downstream greenhouse emissions should be included, whether they occur in Canada or outside the country.
- Keeping in mind the precautionary principle, the review of EAP must discuss how to incorporate consideration of the climate change impacts *of* projects and the climate change risk *on* projects; in other words, it must include provisions for both mitigation of greenhouse gas emissions and adaptation to the impacts of climate change.

For a comprehensive look at the APEGBC response on this issue and on the modernization of the National Energy Board, please see Appendix A which shows the comments APEGBC provided on the Expert Panel Terms of Reference. It may be useful to note that APEGBC feedback has also been incorporated into the feedback that Engineers Canada provided to the federal government. It is expected that this feedback from a professional association's perspective will help the Expert Panel to make recommendations to improve the EAP so that assessments are based on science, facts and evidence and serve the public's interest.

Appendix A – Comments from APEGBC Staff (after reviewing input from the Sustainability Committee, the Division of Environmental Professionals and the Climate Change Advisory Group) on the Expert Panel Terms of Reference Regarding the Modernization of the NEB and Review of Environmental Assessment Processes

Appendix B – Slides for the presentation to the Expert Panel reviewing the Canadian Environmental Assessment Processes

Appendices

Item 5.7	Appendix A
	Appendix B
Item 5.8	Appendix A
	Appendix B
Item 5.9	Appendix A
Item 6.2	Appendix A
	Appendix B
Item 6.3	Appendix A
	Appendix B

FLUOR

PROFESSIONAL SUMMARY

BARRY MESSER

M.Sc.,Chem., Technion, Haifa, 1978
B. Sc, Chem., University of Calgary, Alberta, 1975

SUMMARY

Manager, Materials and Welding Engineering and Technical Director, Fluor Canada Ltd., September 1991 to present

Over 35 years direct experience in the areas of metallurgical engineering, welding engineering, material selection, corrosion control, non-destructive examination development, insulation, coatings, and fabrication related to engineering, procurement, and construction of mining facilities, pipelines, refineries, and petrochemical plants. Regularly involved in material selection, integrity analysis and mitigation of fabrication and in-service failures for Canadian and Global engineering projects. Managed the Metallurgy and Welding department for several new gas, refinery, chemical, enhanced oil recover and water treatment plants.

Fluor is a global engineering, procurement, fabrication, and construction company that conducts activities world-wide; the global range of engineering services provide significant opportunities to be a continuous-learning expert in metallurgy and welding engineering.

Supervisor: Peter Hatcher P.Eng. (Alberta, British Columbia) Engineering, Manager, Director of Projects Operations

Group Leader, Piping Material Engineering, Fluor Canada Ltd.; October 1979 – June 1985

Supervised task force Materials Engineering Group. Developed and reviewed piping engineering specifications and calculations. Provided technical support, guidance, and training of engineering staff.

Supervisor: John Tulissi P.Eng (Alberta) Manager Piping Engineering

Corrosion and Production Engineer, Intel Electronics, August 1987 to August 1991

Built and started up new technology clean rooms and process equipment for semiconductor manufacturing and testing in Jerusalem and Albuquerque.

Supervisor: Adiel Karty, Production Manager

Process Metallurgist, Pratt & Whitney, July 1985 to July 1987

Process Metallurgist for Pratt & Whitney; developed and implemented a new design of directional and single crystal materials for military aerospace F-100 engines for government operations.

Supervisor: Bruce Terkelson PhD, Manager, Metallurgy

BOARD MEMBER AND TECHNICAL SUBJECT MATTER EXPERT

Director, Canadian Welding Bureau, 2008 to present; Involved with addressing regulation of the structural steel welding industry for the safety of public and providing advice and training.

Technical Director, Senior Fellow, Fluor Corp. 2003 to present; Investigates critical issues, facilitates resolution and mitigation of issues, provides advice and guidance to management, colleagues and training support to engineers in training.

TECHNICAL EXPERTISE

- Extensive experience in materials selections, corrosion mitigation, metallurgical and welding engineering
- Identifies corrosion risks and ensures appropriate corrosion strategies are in place on projects. Evaluate cost effectiveness and predictability of delivery
- Investigates critical metallurgical and welding engineering issues for numerous global areas and seeks mitigation and resolution
- Researches new technologies and alternative methods of improved efficiency and quality. Expert in hydrogen sulfide cracking and hydrogen embrittlement issues and mitigation.
- Inventor of:
  - New welding technologies to improve weld quality and productivity and implemented technology successfully on several projects
  - New austenitic stainless steel material for high temperature refinery heater tube service; implemented on several projects
  - New NDE UT TOFD technology for inspection of HDPE plastic piping
  - Determined root cause of low toughness in carbon steel and invented new NDE to determine toughness
- Co-inventor of new chemical cleaning processes to remove oxides from stainless steels, rust from steel and inorganic zinc silicate coatings from Ferritic steels using non-toxic chelating technologies; implemented successfully on engineering projects
- Develop and review material selection diagrams and reports for a variety of piping and equipment on heavy oil gathering and treating projects, SAGD plants, hydrotreater units, chemical and utilities plants, ethylene, amine treating/recovery, air separation, sulphur recovery, hydrogen recovery, gasification, cogeneration units, CO_2 capture, LNG, flare systems and various other facilities.
- Selects materials of construction mining facilities for lead, zinc, cobalt, silver and gold mines, primary and secondary crushing, leach, extraction facilities, electowinning

PROFESSIONAL SUMMARY

- Managed the development of various engineering training and maintenance manuals for power, boilers and high pressure piping lines
- Active at committee and technical level in various engineering associations, NACE, ASME, ASTM, AWS, API, CWA, CWB
- Mentor to engineers in training and develops strategies for knowledge transfer. Provide training on existing and new technologies
- Actively participates in Canadian Welding Bureau board meetings to review strategic plans, governance and welding student bursaries
- Support the drive for engineering excellence and cost control, and encourages change for improvements to engineering work practices. Initiate business opportunities related to engineering solutions
- Acts as a facilitator for resolving complex engineering issues at local and global levels

PATENTS

"Compositions and Methods for Dissimilar Material Welding"

"Ultrasound Phased Array Devices and Methods for Use with Stainless Steel"

"Configurations and Methods for High Resolution Ultrasonic Time of Flight Diffraction (TOFD) Defect Detection for Thermoplastic"

"Compositions, Configurations and Methods for Reducing Naphthenic Acid Corrosivity"

"Improved Methods and Compositions for Stainless Steels"

"Improved Welding Processes for Stainless Steels"

PUBLICATIONS

"Selection of Dissimilar Metal Welds in Severe Environments for Today's Petrochemical Plants", B. Messer, S. Seitz, D. Roth, A. Gray, NACE, Houston, Texas, March 2007.

"Bolted Flange Joints under External Moments: An Analysis using the Compound Gasket approach for Spiral Wound Gaskets", T. Seipp, C. Reichert, B. Messer, Proceedings of ASME PVP2007, San Antonio, Texas, July 2007.

"Advanced Evaluation of Crude Compositions for Optimum Corrosion Resistance and Processing Capabilities", R. Rodgers, B. Messer, A. Marshall, P. Rahimi, T. Phillips, NACE, Houston, Texas, March 2006.

"Details of Complex Waveforms for Gas Metal Arc Welding", B. Messer, C. Patrick, ASME Section IX Task Group on Complex Waveform Power Sources", Henderson NV, August 2006.

Introduction to Complex Waveforms for Gas Metal Arc Welding", B. Messer, C. Patrick, Euroweld Welding Seminar", Edmonton, Alberta, April 2006.

"Achieving Cost Saving with Innovative Welding and Examination Techniques", B. Messer, C. Patrick, S. Seitz, International Journal of Pressure Vessels and Piping, Vol. 83 No.5, May 2006.

"Welding and Examination Advancements Yield Enhanced Cost Savings", B. Messer, S. Seitz, C. Patrick, Electric Power Research Institute (EPRI), Ponte Vedra, Florida, June 2006.

"A Novel Technological Assessment for Welding Heavy Wall Stainless Steel", B. Messer, S. Seitz, C. Patrick, K. Armstrong, ASME Pressure Vessels and Piping Conference, Denver, CO, July 2005.

"Key to Stretching Upper Operating Temperature Limits of 300 Series Stainless Steels for Pressurized Systems", B. Messer, V. Oprea, T. Phillips, Stainless Steel World, February 2005.

"A New Development for Welding Heavy Wall Stainless Steel", B. Messer, S. Seitz, C. Patrick, K. Armstrong, National Pressure Equipment Conference, Banff, Alberta, February 2005.

"Technical Justification for New Cost Saving Welding and Examination Techniques", B. Messer, S. Seitz, C. Patrick, Operating Pressure Equipment Conference, Melbourne, Australia, April 2005.

"Novel Ultrasonic Testing of Complex Welds", B. Messer, J. Fuentes, B. Tarleton, P. den Boer, ASME Pressure Vessels and Piping Conference, Denver, CO, July 2005.

"New Theory for Naphthenic Acid Corrosivity of Athabasca Oilsands Crudes", B. Messer, B. Tarleton, M. Beaton, T. Phillips, NACE, New Orleans, LA, April 2004.

"Optimized Heat Treatment of 347 Type Stainless Steel Alloys for Elevated Temperature Service to Minimize Cracking", B. Messer, V.Oprea, T. Phillips, NACE, New Orleans, LA, April 2004.

"New Developments in Stainless Steels for High Temperature Service in Petroleum Refining", C. Shargay, B. Messer, B. Tarleton, Stainless Steel World Conference, Houston, Texas, October 2004.

"Modified Post Weld Heat Treatment for Chemically Stabilized Stainless Steels", B. Messer, V.Oprea, T. Phillips, NACE, Pittsburgh, PA, September 2003.

"Novel High Resolution Defect Detection for Thermoplastic Butt-Welds", B. Messer, M.Yarmuch, P. den Boer, Pipeline and Gas Journal, March 2003.

"Some Current Issues and Cost Saving Ideas for Stainless Steel use on Refinery New Construction Projects", C. Shargay, B. Messer, Stainless Steel World Conference, Houston, Texas, February 2002.

"New GMAW-S, Welding Process for Stainless Steel Piping Without a Backing Gas", B. Messer, C. Patrick, T. Phillips, G. Lawrence, Welding Research Council Conference, New Orleans, March 2002.

"Welding Stainless Steel Piping With No Backing Gas (NBG)", B. Messer, C. Patrick, G. Lawrence, V. Oprea, T. Phillips, EPRI Conference, June 2002.

"Welding Stainless Steel With No Backing Gas", B. Messer, C. Patrick, G. Lawrence, V. Oprea, T. Phillips, AWS Welding Journal, December 2002.

"An Austentic Stainless Steel Resistant to High Temperature Creep and Naphthenic Acids Attack in Refinery Environments", D. Dove, B. Messer, T. Phillips, NACE, Houston, Texas, March 2001.

"Design Considerations to Minimize Ammonium Chloride Corrosion in Hydrotreater Reactors", C. Shargay, J. Turner, B. Messer, NACE, Houston, Texas, March 2001.

PROJECT HISTORY

Treatment and Dewatering Gas Plants
Encana Corp, Dawson Creek, BC
Dawson Creek, BC
Gas Treatment, Sand and Water Removal, 3 Locations
Sunrise, Tower, Saturn

North American Polypropylene (NAPP)
Redwater, Alberta, Canada
Homopolymer propylene

Williams Alberta PDH Project
Williams Canada Redwater, Alberta
Propane Dehydration,
Polymer Grade Propylene

Gas Gathering, Dewatering and LNG Facility
Santos, Queensland, Australia

Sturgeon Refinery Project Units 10 Crude and Vacuum, 20 Hydrofiner, 30 Hydroprocessor.
North West Redwater Partnership, Sturgeon County, Alberta, Canada

Enbridge Pipeline Alliance
Enbridge, various Alberta locations

Petro Canada Oil Sands Inc. (PCOSI), Sturgeon County, Alberta

Toledo Refinery Expansion
Sonoco Inc., Toledo, Ohio

Safford Leach Project, Copper Mine
Phelps Dodge Mining Co., Safford, Arizona, United States

Hydrocracker Project
Valero Refining/Tesoro Refining, St. Charles, Louisiana, Port Arthur, Texas, U.S.

Fort Hills Oils Sands Project, Fort Hills, Alberta
Suncor Energy, Canada

Pueblo Viejo Gold Processing,
Pueblo Viejo Dominicana Corporation, Cotui, Dominican Republic

Benzene Reduction Project – FEL3 & Detailed Design
Tesoro Refining Co., Anacortes Washington

Cerro Verde II Production Unit Expansion Project
Freeport-McMoran Copper & Gold Inc. Arequipa,, Peru

East Tank Farm Development Project,
Suncor Energy Oil Sands Limited Partnership, Fort McMurray, Alberta, Canada

Master Services Agreement
Nexen Inc., Fort McMurray, Alberta, Canada

Mildred Lake Mine Replacement
Imperial Oil Resources Ventures Limited, Fort McMurray, Alberta, Canada

Peñasquito Copper and Gold Mine Project
Goldcorp Inc., Mazapil, Zacatecas, Mexico

High Pressure Piping and Boiler Training and Inspection Manuals – Consulting
SaskPower, Regina, Saskatchewan

Highland Valley Copper Mill Optimization Project - EPC/CM
Highland Valley, British Columbia

Kearl Expansion Project - Construction Management and Support Services Phase 2
Imperial Oil Resources Ventures Limited, Fort McMurray, Alberta, Canada

Long Harbour Nickel Processing Plant
Vale Newfoundland & Labrador Ltd, Long Harbour, Newfoundland, Canada

MacKay River Phase 2 FEED
Suncor Energy Services Inc., Fort McMurray, Alberta, Canada

Quest Carbon Capture and Storage
Shell Canada Energy, Fort Saskatchewan, Alberta, Canada

Sierra Gorda Copper Project
Quadra FNX Mining Ltd., Sierra Gorda, Chile

Kitimat LNG Plant FEED
Chevron Canada Ltd., Kitimat, British Columbia, Canada

Mt. Milligan Copper Mine EPCM
Thompson Creek Metals Company Inc., Prince George, B.C., Canada

Pueblo Viejo Gold Processing Facility
Pueblo Viejo Dominicana Corporation, Cotui, , Dominican Republic

Benzene Reduction Project - FEL3 and Detailed Design
Tesoro Refining & Marketing Company, Anacortes, Washington, United States

Long Lake Upgrader Phase 2
Nexen Inc., Fort McMurray, Alberta, Canada

Athabasca Upgrader
Total E&P Canada, Strathcona County, Alberta, Canada

Eider Rock
Irving Oil Limited, BP Ltd., Saint John, New Brunswick, Canada

Jubail Acetyls Complex - AA, VAM & Utilities
SIPChem, Al Jubail, Saudi Arabia

St. Charles Hydrocracker Unit
Valero Refining Co., New Orleans LLC, St. Charles, Louisiana, United States

Toledo Refinery Expansion
Sonoco Inc., Toledo, Ohio, United States

Safford Leach Project – EPCM
Freeport-McMoran Copper & Gold Inc., Safford, Arizona, United States

Horizon Oil Sands Project, Utilities and Offsites
Canadian Natural Resources Limited, Fort McMurray, Alberta, Canada

Lloydminster Upgrader Expansion
Husky Oil Operations Limited, Lloydminster, Saskatachewan, Canada

Philadelphia and Eagle Point ULSD
Sonoco Inc., Philadelphia, Pennsylvania, United States
Ultra Low Sulfur Diesel

HATGU Refinery
Irving Oil Limited, Saint John, New Brunswick, Canada

Low Sulphur Gasoline
4 Refineries
Sonoco Inc. (various locations)

Ethylene 3 Plant Project
Nova Chemicals Ltd., Joffre, Alberta

Ethylene 2 Debottlenecking 2
Nova Chemicals Inc., Joffre, Alberta

Refinery Upgrade
Sunoco Inc., Toledo, Marcus Hook, Philadelphia, Eagle Point, United States

Syncrude Upgrading Expansion (UE-1) Project
Syncrude Canada Ltd., Mildred Lake Site, Fort McMurray , Alberta

EP Engineering Services,
OPTI/Nexen Long Lake Upgrader Project
OPTI Canada Inc., Calgary/Long Lake, Alberta

Engineering Services Alliance
Ultramar Ltd., St. Romuald, Quebec, Canada

Quest Carbon Capture and Storage
Shell Canada Energy, Fort Saskatchewan, Alberta
CO2 capture and compression facilities,1.2 million tonnes of CO2 per year.

Irving Oil Engineering and Construction Alliance
Irving Oil Limited, Saint John, New Brunswick

Oil Sands Bitumen Extraction Facility,
Kearl Oil Sands Project
Imperial Oil Resources Ventures Limited, Fort McMurray, Alberta
Infrastructure and off-lease project.

Utilities and Offsites
Kuwait National Petroleum Company, Al Zour , Kuwait
Utilities, offsites and marine facilities, (KNPC)

Benzene Reduction Project
Tesoro Refining Co
Anacortes, Washington

Toledo Refinery Expansion
Sunoco Inc., Toledo, Ohio

Hydrocracker Project
Valero Refining / Tesoro Refining, St. Charles, Louisiana, Port Arthur, Texas

Fort Hills Oil Sands Project
Suncor Energy, Canada
Bitumen extraction and tailings project for oil sands production

Refinery Upgrader (PCOSI)Fort Hills Energy LP, Canada
240 kBPSD SCO grassroots oil sands upgrader.

Refinery Upgrader
OPTI/Nexen Long Lake Upgrader Project, Long Lake
OrCrudeTM upgrader, hydrocracker, amine treating/recovery, air separation, sulphur recovery, hydrogen recovery, gasification and cogeneration units, overall utilities, offsites and infrastructure.

Power Generation Station
Saskatchewan Power Corporation, Regina, Saskatchewan
Boiler Training and Inspection Manuals

Horizon Oil Sands Project
Canadian Natural Resources Ltd., Fort McMurray, Alberta
OSBL EP for grassroots oil sands facility

Engineering Services Alliance
Ultramar Ltd, St. Romuald, Quebec
Ongoing EP services, over a 5 year period, for a 200,000 bpd refinery

Conceptual and detailed engineering design PDVSA
Husky Oil Ltd., Lloydminster, Saskatchewan
Design of a Intevep,5,000 B/D steamflood and enhanced oil recovery facility.

Conceptual and detailed engineering design
Suncor Inc., Burnt Lake, Alberta
Design of a 2,000 B/D steamflood and enhanced oil recovery facility.

Water Treatment Facility
CN Exploration Ltd., Kerrobert, Saskatchewan
Modularized Water treatment plant for waterflood enhanced oil recovery.

Mt. Milligan Copper-Gold Mine Project
Thompson Creek Metals, Canada
60,000-tons-per-day copper flotation processing plant and infrastructure.

Pueblo Viejo EPCM Project
Barrick Gold Corporation, Dominican Republic
Barrick Gold, Pueblo Viejo Gold Plant Project.

Oyu Tolgoi Project - Phase I,
Ivanhoe Mines/Rio Tinto, Southern Gobi Desert, Mongolia
Concentrator Project

Oyu Tolgoi Mine Project
Ivanhoe Mines/Rio Tinto, Oyu Tolgoi Copper, Southern Gobi Desert, Mongolia
Copper and Gold processing plant

Long Harbour Nickel Processing Plant
Vale Inco NL Ltd. Newfoundland
Nickel processing plant, using hydrometallurgical technology, 50,000 tonnes per year of finished nickel product, together with associated cobalt and copper products.

Safford Leach Project EPCM & Various Projects
Freeport-McMoran Copper & Gold Inc.,
Bagdad Incremental Expansion

El Abra Sulfolix Project
Freeport-McMoRan, Chile
Copper ore heap leaching project

Cerro Verde Primary Sulphide Project
Freeport-McMoRan, Chile
Copper concentrator and mine expansion with HPGR units

Safford Leach Project
Freeport-McMoRan, Chile
Copper leach SX/EW plant

Sakhalin 1
Exxon Neftgas, Russia
Modularized offshore gas production facility

Muskeg River Project
Albian Sands Energy, Alberta, Canada
New oil sands mine development and extraction plantf

Syncrude Upgrading Expansion
Syncrude Canada Ltd.,
(UE-1) Project - EPC Phase, Mildred Lake Site
Plant Expansion to 350K BPD, of Syncrude Sweet Blend, Fort McMurray, Alberta

Ethylene 3 Plant Project Nova Chemicals Ltd.
2.81 Billion lbs/year grass rootsJoffre, Alberta

Ethylene 2 Debottlenecking 2
Nova Chemicals Inc., Joffre, Alberta
A 10% capacity increase of an existing ethylene plant.

(PRISM) Sulphur Reduction Projects
Imperial Oil Limited, Strathcona, Alberta, Nanticoke, Ontario, Dartmouth, Nova Scotia

Athabasca Oil Sands Downstream Project
Shell Canada Limited, Fort Saskatchewan, Alberta
Scotford Refinery , EPC of Primary Process Units

Shell Canada Athabasca Oil Sands
Shell Canada Resources Ltd., Fort Saskatchewan, Alberta
Downstream Project, Scotford MODS

Project Management Services
Saudi International Petrochemical Corp., Al-Jubail, Saudi Arabia
Project management services for a Methanol, Butanediol, Acetic Acid and Vinyl Acetate Petrochemical Complex

Hydrocarbon Liquids Conservation Project
Williams Energy (Canada) Inc., Fort McMurray, Alberta, Redwater, Alberta
Liquids recovery facility and an OLE fins fractionation train

Norco Refinery Expansion Project
TransAmerican Refining Corporation, Norco, Louisiana
Delayed Coker Unit, associated gas plant and amine contactor, modifications to the interconnecting piping cooling towers and completion of the new tank farm

Cogen Project
TransAlta Energy Corporation, Fort McMurray, Alberta
360 MW Combined Cycle Cogeneration
Power, Steam and Support Facilities

Polyethylene Plant
Union Carbide, Prentiss, Alberta LP7 Project
Grassroots 1.3 B lb/yr Low Pressure

Refinery Upgrade
Irving Oil Limited, Saint John, New Brunswick
Engineering, Procurement and Construction Management for a 250,000 BPD Refinery Upgrade

Suncor Millennium Energy Services
Suncor Energy Inc., Fort McMurray, Alberta

Piping Interconnects Project
Agrium Inc., Carseland, Alberta
1,600 MTPD Ammonia/2,350 MTPD Urea Plant Expansion

Tail Gas Incinerator and Stack
Westcoast Energy Inc., Taylor, British Columbia

Sour Gas Processing Facility
Westcoast Energy Inc., Tumbler Ridge, British Columbia
Sour gas processing 575 MMSCFD and 2,700 tonne/day Sulphur production facility

Hydrogen Peroxide Facility
DuPont Canada Inc., Gibbons, Alberta
EPC of a 36,000 tonnes /yr. Grass Roots Hydrogen Peroxide facility.

FCCU Revamp Project
Chevron USA, Salt Lake City, Utah

Hydro-Treater Project
Petro-Canada Clarkson, Ontario
EPCM of a new 8,000 b/d White Oil Hydrotreater Unit

Vapor Recovery Project
Alyeska Pipeline Co., Valdez, Alaska

Steam Power Plant Extension Stage IV
Saudi Consolidated Electric Company, Rabigh, Saudi Arabia

Gasoline Blending Unit
Unocal Corporation, Wilmington, California

ARCO Polypropylene Project
ARCO Polypropylene, Los Angeles, California

Process Facility Modification
U.S. Department of Energy, Hanford, Washington
(PFMP) Waste Processing

Altamira Cogeneration Project
Enertek S.A. de C.V., Tampico, Mexico

Refinery Alky Debottlenecking Project
Arco Alky, Carson, California

Refinery WCN HDS Project
Honam Oil Refinery Co., Ltd., Yocheon, Korea

Grass Roots Refinery of 100,000 B/D
Pertamina , Cilacap, Indonesia
100,000 B/D

Refinery Expansion
Pertamina , Cilacap, Indonesia
Expansion of 200,000 B/D

Pertamina Cilacap Debottlenecking Project
Pertamina, Cilacap, Indonesia

Engineering Services for Refinery Expansion
Honam Oil Refinery Co., Ltd., Yocheon, Korea

Pemex Cryogenic II Project
Pemex Gas y Petroquimica Basica (PGyPB), Tabasco, Mexico

Cryogenic No. 1 Fire Rebuild
Pemex Gas y Petroquimica Basica (PGyPB)
Debottlenecking Project
Chiapas, Mexico, Cactus Complex

Ruwais Refinery Expansion Project
Abu Dhabi National Oil Company (ADNOC), Ruwais, Abu Dhabi,
FEED Services

Kero/Diesel HDS Project
LG-Caltex Oil Corporation, Yochon Refinery, Korea
60 MBSD Kero/Diesel

Cogeneration Project
Union Carbide Taft Infrastructure, Taft, Louisiana
257 MW gas fired combined-cycle Consolidation (TIC)

Cogeneration facility
Shell/SIPM, Rayong Refinery, Thailand
145,000 bbl/d Grassroots Refinery

Hydrofiner and SRU/ARU Modifications Project
Imperial Oil Limited. Nanticoke, Ontario
Modifications for a 28,000 barrel per day diesel hydrofiner and offsites work.

Polystyrene Plant
Chevron Chemical Company, Zhangjiagang, Jiangsu Province, China
100,000 tonnes per year

Ethylene Oxide/ Glycol Plant Expansion
Alberta and Orient Glycol Co. Ltd., (Union Carbide Canada Ltd.), Prentiss, Alberta
227,000 t/a (500 x 106 lb/yr)

Methanol plant
Qatar Fuel Additive Co. (QAFAC), Umm Said, Qatar
Grassroots 543,000 MTPA MTBE and 2,000 MTPD

Heavy Oil Refinery
Maraven HpH Complex,Intevep, PDVSA , Los Teques, Venezuela, South America
Hydrocracking, Desulphurization, and Hydrotreating of Heavy Oils

Linear low density Polyethylene Plant
Novacor Chemicals Ltd., Joffre, Alberta
Grass roots 272,000 t/d (600 x 106 lb/yr) linear low density polyethylene plant

Ethylene oxide/Glycol project
Union Carbide Canada Ltd., Prentiss, Alberta
Grass roots 227,000 t/a (500 x 106 lb/yr)

Ethylene glycol terminal
Union Carbide Canada Ltd., Blackfalds, Alberta
Ethylene glycol loading terminal, including 18 km pipeline, storage and automated loading and metering system

Heavy Oil Upgrader
Esso Resources Ltd., Cold Lake, Alberta
Engineering, procurement and construction of a 22 260 m3/d (140,000 b/d) Heavy Oil Upgrading Project

Utilities and Offsite detailed engineering
Syncrude Canada Ltd., Fort McMurray, Alberta
Process and detailed engineering packages for all utilities and offsites work associated with the Capacity Addition Program at major oil sands upgrading facility.

Gas Plant
Westcoast Transmission/ Petro-Canada, Taylor, British Columbia
G10.65 x 106 m3/d (375 x 106 scfd) gas plant, ethane, and propane plus extraction using the turbo-expander process

Coker fix-up projecty
Syncrude Canada Ltd., Fort McMurray, Alberta

Steam distribution header replacement project
Syncrude Canada Ltd., Fort McMurray, Alberta

UpgraderRefinery Project
Co-Op Regina, Saskatchewan
7950 m3/d (50,000 b/d) of sour crude. The project consists of new process units and revamps to existing units and offsites

Refinery expansion and modernization project
Ultramar Canada Inc., St. Romuald, Quebec
4 770 m3/d (30,000 b/d)

Methanol plant
Petralgas Chemicals NZ Ltd., Waitara, New Zealand
Grass roots 1,200 t/d (1300 T/D)

Methanol Plant Expansion
Alberta Gas Chemicals Ltd., Medicine Hat, Alberta
1,090 t/d (1,200 T/d) Expansion including integration of utilities into the existing facility

Gas Plant Expansion
Canterra Energy Ltd./ Aquitaine Co. of Canada Ltd., Ram River, Alberta
5.66 x 106 m3/d (200 x 106 scfd)Plan expansion including dehydration, sweetening, dew point control,
and offsite facilities

Carbon Dioxide Extraction Plant
Esso Resources Canada Ltd., Judy Creek, Alberta
FEED for a 2.3 x 106 m3/d (80 x 106 scfd) Carbon Dioxide Extraction Plant including integration to existing and planned facilities

Construction and Start up of a Microchip Fabrication Facility
Intel Electronics Ltd., Albuquerque, New Mexico, USA
Coordinated build of semiconductor class 1 clean room and start up related to new technology semiconductor manufacturing processes.

Aerospace Manufacturing and metallurgical technical support
Pratt & Whitney, USA
F-100 engine materials development and implementation

END OF DOCUMENT

Professional Engineers and Geoscientists of BC
www.apeg.bc.ca

The Association of Professional Engineers and Geoscientists of the Province of British Columbia
200-4010 Regent Street
Burnaby BC V5C 6N2
(tel.) 604.430.8035 (fax) 604.430.8085
(w) www.apeg.bc.ca
(email) register@apeg.bc.ca

REFERENCE FORM FOR LIMITED LICENCE (Engineering Licensee/Eng.L. and Geoscience Licensee/Geo.L)

PLEASE TYPE OR PRINT LEGIBLY

Referee Name: Peter Hatcher	**Applicant [Full Legal] Name:** Barry Messer	
Referee Address: 55 Sunpark Plaza SW Calgary, Alberta T2X3R4	**Applicant Email:** barry.messer@fluor.com	**Applicant ID Number:** 189631
	Scope of Limited Licence: Field of Practice: Material Selection and Welding Limited to: 1. energy, chemical and mining facilities 2. selecting materials of construction considering chemical and microbial resistance and mechanical properties of materials 3. welding, heat treatment and non-destructive examination procedures 4. evaluation of corrosion mechanisms	
Date: April 15, 2016		

Your name has been put forward by this applicant as a Referee to verify his/her experience for granting of a Limited Licence. It is important to the applicant, as well as the Association that you complete the form and return it. **Please refer to the enclosed Proposed Scope of Practice and experience record supplied by the applicant.** Please answer all questions to the best of your **direct** knowledge only. Second-hand information is of little value. Please **do not suppress any information which might influence the decision**. Because granting of Limited Licence is based upon evaluation by professional engineers or professional geoscientists, the evaluations of referees are critical to the process.

If for any reason, you feel that you cannot provide an assessment of this applicant, please return this form to the Association and note your reasons below in the space provided. All statements will be treated as confidential. Thank you for taking part in this most important aspect of the licensing process.

REFEREE INFORMATION

Position	Vice President, Engineering	**Professional Designation (P.Eng./P.Geo. etc)**	P.Eng.
Employer	Fluor Canada Ltd.	**Discipline of Engineering/Geoscience**	Metallurgical Engineering
Registration/Licence #	41570	**Jurisdiction of Registration**	APEGBC

Telephone Number: 4035374057 Email: peter.hatcher@fluor.com

If you are unable to act as a referee, please indicate the reason in the space provided:

1

Docs #71683

A. **YOUR PERSONAL KNOWLEDGE OF THE APPLICANT**

1. For how many years have you known the applicant

Personally: _____ From (please provide dates) _____ to _____

Professionally: 21 From (please provide dates) 1995 to present

2. In your opinion, is the applicant's character:

■ Acceptable ☐ Not acceptable (please elaborate below)

B. **YOUR PROFESSIONAL KNOWLEDGE OF THE APPLICANT**

(Please provide additional comments which may assist the Registration Committee in its decision.)

1. What is or was your professional relationship to the applicant?

■ Supervisor ☐ Client ■ Colleague ☐ Other (*please describe*)

2. have you been professionally associated with the applicant and for what period during this time, has the applicant been engaged in engineering or geoscience?

I have been professionally associated with Barry since April 1995. Barry has been engaged in engineering and geoscience for this entire period.

3. In your opinion, are the applicant's English language skills related to the provision of engineering or geoscience services at a level sufficient to protect the interest of the public in British Columbia?

Speaking	■ Excellent	☐ Satisfactory	☐Unsatisfactory
Writing	■ Excellent	☐ Satisfactory	☐Unsatisfactory
Listening	■ Excellent	☐ Satisfactory	☐Unsatisfactory
Reading	■ Excellent	☐ Satisfactory	☐Unsatisfactory

Comments

4. In your opinion does the applicant

- apply engineering/geoscience principles in a knowledgeable and accurate manner? ☐ Yes ☐ No

- possess sound professional judgment? ☐ Yes ☐ No

- have the ability to recognize and work within his/her limitations? ☐ Yes ☐ No

- adhere to APEGBC's Code of Ethics? ☐ Yes ☐ No

C. YOUR ASSESSMENT OF THE APPLICANT'S EXPERIENCE

1. The purpose of the limited licence review process is to ascertain whether or not the applicant is ready to accept full professional responsibility for work performed and understands his/her limitations. Satisfactory experience involves the application of engineering or geoscience principles and theory, showing progression by evidence of increasing complexity and responsibility. It is requested that you review the enclosed summary of experience provided by the applicant and comment on its validity. Also, please emphasize any areas in which you judge the applicant to have gained outstanding experience. (Attach extra pages if necessary.) Please specify types of experience gained by the applicant ***relevant to the requested scope of licence***, and which you can confirm.

I have reviewed the summary of experience provided by Barry. For the period April 1995 to present I confirm the validity of the information provided.

Barry is an expert in material engineering and welding engineering particularly as it applies to oil & gas, chemicals and mining facilities.

Barry has significant knowledge that he has applied in the selection of materials for various services with full consideration of code, regulations, good practice, safety and economic considerations.

Barry has applied sound engineering principals when determining the best methods for joining, treating and testing joints for metallic and non-metallic components.

Barry has advanced skills and experience related to selection of materials in corrosive environments based on fundamental understanding of corrosion mechanisms and the interaction of materials in those environments.

2. You are asked to judge how much of the applicant's experience with which you are specifically familiar was:

Type of Experience	Duration (Number of years/months)	Dates	
		From (Month/Year)	To (Month/Year)
At a Non Technical Level			
Training/Familiarization			
At a Engineering/Geoscience Level	1 yr 9 mo	April/1995	Dec/1997
At a Professional Level and Under Direct Supervision of a P.Eng/P.Geo	19 yr	Jan/1997	present

3. In your judgment, is the applicant qualified by experience to practice at a **professional level within the scope of licensure requested?** If your answer is YES please be certain that the applicant can accept full professional responsibility including judging accurately when he/she is our of his/her depth.

■ Yes ☐ No (Please elaborate below)

D. **ADDITIONAL INFORMATION**

1. If you have any additional information which will assist in our evaluation, please provide it below.

2. If, for any reason, you believe that granting of Limited Licensure to the applicant should be withheld at this time, please comment below.

Signature		Date	

Please return this form, with a copy of the applicant's work experience summary, to:
APEGBC, 200-4010 Regent Street, Burnaby BC V5C 6N2, Canada
or Fax to 604-430-8085
Forms can also be emailed with applicants permission to register@apeg.bc.ca
THANK YOU FOR TAKING THE TIME TO PROVIDE THIS REFERENCE.

Professional Engineers and Geoscientists of BC
www.apeg.bc.ca

The Association of Professional Engineers and Geoscientists of the Province of British Columbia
200-4010 Regent Street
Burnaby BC V5C 6N2
(tel.) 604.430.8035 (fax) 604.430.8085
(w) www.apeg.bc.ca
(email) register@apeg.bc.ca

REFERENCE FORM FOR LIMITED LICENCE (Engineering Licensee/Eng.L. and Geoscience Licensee/Geo.L)

PLEASE TYPE OR PRINT LEGIBLY

Referee Name:	**Applicant [Full Legal] Name:**	
Puay Hean Lim	Barry Messer	
Referee Address:	**Applicant Email:**	**Applicant ID Number:**
125 Copperpond Parade SE, Calgary, AB T2Z 5A9	barry.messer@fluor.com	189631
	Scope of Limited Licence: Material Selection Welding, Heat Treatment and Non-Destructive Examination Insulation Coatings	
April 11, 2016 **Date:**		

Your name has been put forward by this applicant as a Referee to verify his/her experience for granting of a Limited Licence. It is important to the applicant, as well as the Association that you complete the form and return it. **Please refer to the enclosed Proposed Scope of Practice and experience record supplied by the applicant.** Please answer all questions to the best of your **direct** knowledge only. Second-hand information is of little value. Please **do not suppress any information which might influence the decision**. Because granting of Limited Licence is based upon evaluation by professional engineers or professional geoscientists, the evaluations of referees are critical to the process.

If for any reason, you feel that you cannot provide an assessment of this applicant, please return this form to the Association and note your reasons below in the space provided. All statements will be treated as confidential. Thank you for taking part in this most important aspect of the licensing process.

REFEREE INFORMATION

Position	Piping Material Engineer	**Professional Designation (P.Eng./P.Geo. etc)**	P.Eng
Employer	Fluor Canada Ltd.	**Discipline of Engineering/Geoscience**	Mechanical
Registration/Licence #	41395	**Jurisdiction of Registration**	British Columbia & Alberta

Telephone Number: 403-537-5265 Email: puay.lim@fluor.com

If you are unable to act as a referee, please indicate the reason in the space provided:

1

Docs #71683

A. YOUR PERSONAL KNOWLEDGE OF THE APPLICANT

1. For how many years have you known the applicant:

Personally: 17 From (please provide dates) 1999 to present

Professionally: 17 From (please provide dates) 1999 to present

2. In your opinion, is the applicant's character:

☒ Acceptable ☐ Not acceptable (please elaborate below)

B. YOUR PROFESSIONAL KNOWLEDGE OF THE APPLICANT

(Please provide additional comments which may assist the Registration Committee in its decision.)

1. What is or was your professional relationship to the applicant?

☐ Supervisor ☐ Client ☐ Colleague ☒ Other *(please describe)*

Barry was my supervisor from 1999 to 2000, and from 2001 to 2007.
Since then we have been colleagues working in different groups.

2. have you been professionally associated with the applicant and for what period during this time, has the applicant been engaged in engineering or geoscience?

Please refer to Question A.1 above. For this period of time, Barry has been engaged in Engineering.

3. In your opinion, are the applicant's English language skills related to the provision of engineering or geoscience services at a level sufficient to protect the interest of the public in British Columbia?

Speaking	☒ Excellent	☐ Satisfactory	☐Unsatisfactory
Writing	☒ Excellent	☐ Satisfactory	☐Unsatisfactory
Listening	☒ Excellent	☐ Satisfactory	☐Unsatisfactory
Reading	☒ Excellent	☐ Satisfactory	☐Unsatisfactory

Comments

4. In your opinion does the applicant

- apply engineering/geoscience principles in a knowledgeable and accurate manner? ■ Yes ☐ No

- possess sound professional judgment? ■ Yes ☐ No

- have the ability to recognize and work within his/her limitations? ■ Yes ☐ No

- adhere to APEGBC's Code of Ethics? ■ Yes ☐ No

C. YOUR ASSESSMENT OF THE APPLICANT'S EXPERIENCE

1. The purpose of the limited licence review process is to ascertain whether or not the applicant is ready to accept full professional responsibility for work performed and understands his/her limitations. Satisfactory experience involves the application of engineering or geoscience principles and theory, showing progression by evidence of increasing complexity and responsibility. It is requested that you review the enclosed summary of experience provided by the applicant and comment on its validity. Also, please emphasize any areas in which you judge the applicant to have gained outstanding experience. (Attach extra pages if necessary.) Please specify types of experience gained by the applicant ***relevant to the requested scope of licence***, and which you can confirm.

I can confirm that the enclosed summary of experience is valid for the duration mentioned in Question A.1 above. Barry is well respected within Fluor as well as in the industry. He particularly has extensive experience in the field of selection of materials of construction for piping and equipment, welding metallurgy, heat treatment, and non-destructive examination methods. He is regularly involved in these aspects on the various projects listed in the summary of experience. He also authors papers on these subjects.

2. You are asked to judge how much of the applicant's experience with which you are specifically familiar was:

Professional Engineers and Geoscientists of BC
www.apeg.bc.ca

The Association of Professional Engineers and Geoscientists of the Province of British Columbia
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(w) www.apeg.bc.ca
(email) register@apeg.bc.ca

REFERENCE FORM FOR LIMITED LICENCE (Engineering Licensee/Eng.L. and Geoscience Licensee/Geo.L)

PLEASE TYPE OR PRINT LEGIBLY

Referee Name:	Applicant [Full Legal] Name:	
Dennis R. Maki, P.Eng. (BC,Alta)	Barry Messer, M.Sc.	
Referee Address:	**Applicant Email:**	**Applicant ID Number:**
55 Sunpark Plaza SE Calgary, Alberta T2X 3R4	Barry.Messer@Fluor.com	
	Scope of Limited Licence:	
Date: March 1, 2016		

Your name has been put forward by this applicant as a Referee to verify his/her experience for granting of a Limited Licence. It is important to the applicant, as well as the Association that you complete the form and return it. **Please refer to the enclosed Proposed Scope of Practice and experience record supplied by the applicant.** Please answer all questions to the best of your **direct** knowledge only. Second-hand information is of little value. Please **do not suppress any information which might influence the decision**. Because granting of Limited Licence is based upon evaluation by professional engineers or professional geoscientists, the evaluations of referees are critical to the process.

If for any reason, you feel that you cannot provide an assessment of this applicant, please return this form to the Association and note your reasons below in the space provided. All statements will be treated as confidential. Thank you for taking part in this most important aspect of the licensing process.

REFEREE INFORMATION

Position	Sr. Design Engineer	**Professional Designation (P.Eng./P.Geo. etc)**	P.Eng
Employer	Fluor Canada Ltd.	**Discipline of Engineering/Geoscience**	Metallurgical
Registration/Licence #	#41994	**Jurisdiction of Registration**	BC

Telephone Number: 403 537 4933 **Email:** Dennis.Maki@Fluor.com

If you are unable to act as a referee, please indicate the reason in the space provided:

1

Docs #71683

A. YOUR PERSONAL KNOWLEDGE OF THE APPLICANT

1. For how many years have you known the applicant:

Personally:	11	From (please provide dates)	July 2004	to	Present
Professionally:	11	From (please provide dates)	July 2004	to	Present

2. In your opinion, is the applicant's character:

■ Acceptable ☐ Not acceptable (please elaborate below)

B. YOUR PROFESSIONAL KNOWLEDGE OF THE APPLICANT

(Please provide additional comments which may assist the Registration Committee in its decision.)

1. What is or was your professional relationship to the applicant?

■ Supervisor ☐ Client ■ Colleague ☐ Other (*please describe*)

I commenced my Employment with Fluor Canada in July 2004, With Barry Messer as my Technical and Administrative Leader for Metallurgy and Welding

2. have you been professionally associated with the applicant and for what period during this time, has the applicant been engaged in engineering or geoscience?

I have worked for and With Barry Messer over the Time Period of July 2004 to the Present. Barry has handled much of the high level internal consulting work with Fluor Corporation.

3. In your opinion, are the applicant's English language skills related to the provision of engineering or geoscience services at a level sufficient to protect the interest of the public in British Columbia?

Speaking	■ Excellent	☐ Satisfactory	☐ Unsatisfactory
Writing	■ Excellent	☐ Satisfactory	☐ Unsatisfactory
Listening	■ Excellent	☐ Satisfactory	☐ Unsatisfactory
Reading	■ Excellent	☐ Satisfactory	☐ Unsatisfactory

Comments

Barry is a Canadian University Science Graduate, and has no English Fluency Difficulties.

4. In your opinion does the applicant

- apply engineering/geoscience principles in a knowledgeable and accurate manner? ■ Yes ☐ No

- possess sound professional judgment? ■ Yes ☐ No

- have the ability to recognize and work within his/her limitations? ■ Yes ☐ No

- adhere to APEGBC's Code of Ethics? ■ Yes ☐ No

C. YOUR ASSESSMENT OF THE APPLICANT'S EXPERIENCE

1. The purpose of the limited licence review process is to ascertain whether or not the applicant is ready to accept full professional responsibility for work performed and understands his/her limitations. Satisfactory experience involves the application of engineering or geoscience principles and theory, showing progression by evidence of increasing complexity and responsibility. It is requested that you review the enclosed summary of experience provided by the applicant and comment on its validity. Also, please emphasize any areas in which you judge the applicant to have gained outstanding experience. (Attach extra pages if necessary.) Please specify types of experience gained by the applicant ***relevant to the requested scope of licence***, and which you can confirm.

Barry's experience in the nuances of metallurgy and welding in all Mining, Chemical, and Oils Sands Areas is extremely comprehensive.

Barry is the holder of several Patents related to Chemical Plant Processes and Welding Processes. I participated with Barry in obtaining a Patent for the Friction Stirred Welding Process.

2. You are asked to judge how much of the applicant's experience with which you are specifically familiar was:

Type of Experience	Duration (Number of years/months)	Dates	
		From (Month/Year)	To (Month/Year)
At a Non Technical Level			
Training/Familiarization			
At a Engineering/Geoscience Level			
At a Professional Level and Under Direct Supervision of a P.Eng/P.Geo	11 Years 8 Months	July 2004	Present

3. In your judgment, is the applicant qualified by experience to practice at a **professional level within the scope of licensure requested?** If your answer is YES please be certain that the applicant can accept full professional responsibility including judging accurately when he/she is our of his/her depth.

■ Yes ☐ No (Please elaborate below)

D. **ADDITIONAL INFORMATION**

1. If you have any additional information which will assist in our evaluation, please provide it below:

I will be retiring from Fluor Canada Ltd in May 2016, but plan to maintain my Professional Status in BC and Alberta. I can be contacted at my Home Address after May 12, 2016.

2. If, for any reason, you believe that granting of Limited Licensure to the applicant should be withheld at this time, please comment below:

Signature	APPROVED By Dennis R. Maki, P.Eng. at 8:51 am, Mar 01, 2016	Date March 1, 2016	

Please return this form, with a copy of the applicant's work experience summary, to:
APEGBC, 200-4010 Regent Street, Burnaby BC V5C 6N2, Canada
or Fax to 604-430-8085
Forms can also be emailed with applicants permission to register@apeg.bc.ca
THANK YOU FOR TAKING THE TIME TO PROVIDE THIS REFERENCE.

Professional Engineers and Geoscientists of BC
www.apeg.bc.ca

The Association of Professional Engineers and Geoscientists of the Province of British Columbia
200-4010 Regent Street
Burnaby BC V5C 6N2
(tel.) 604.430.8035 (fax) 604.430.8085
(w) www.apeg.bc.ca
(email) register@apeg.bc.ca

REFERENCE FORM FOR LIMITED LICENCE (Engineering Licensee/Eng.L. and Geoscience Licensee/Geo.L)

PLEASE TYPE OR PRINT LEGIBLY

Referee Name:	**Applicant [Full Legal] Name:**	
Jayne Nichols, P.Eng.	Barry Messer	
Referee Address:	**Applicant Email:**	**Applicant ID Number:**
Fluor Canada Ltd 55 Sunpark Plaza SE Calgary, Alberta T2X 3R4	barry.messer@fluor.com	
	Scope of Limited Licence: Discipline: Mechanical Engineering, Field of Practice: Material Science and Welding Limited to: 1. Energy, chemical and mining facilities 2. Selecting materials of construction considering chemical and microbial resistance and mechanical properties of materials 3. welding, heat treatment and non-destructive examination procedures 4. evaluation of corrosion mechanisms	
Date: 19 April 2016		

Your name has been put forward by this applicant as a Referee to verify his/her experience for granting of a Limited Licence. It is important to the applicant, as well as the Association that you complete the form and return it. **Please refer to the enclosed Proposed Scope of Practice and experience record supplied by the applicant.** Please answer all questions to the best of your **direct** knowledge only. Second-hand information is of little value. Please **do not suppress any information which might influence the decision**. Because granting of Limited Licence is based upon evaluation by professional engineers or professional geoscientists, the evaluations of referees are critical to the process.

If for any reason, you feel that you cannot provide an assessment of this applicant, please return this form to the Association and note your reasons below in the space provided. All statements will be treated as confidential. Thank you for taking part in this most important aspect of the licensing process.

REFEREE INFORMATION

Position	Department Manager Mechanical Engineering	**Professional Designation (P.Eng./P.Geo. etc)**	P.Eng.
Employer	Fluor Canada Ltd.	**Discipline of Engineering/Geoscience**	Mechanical / Piping Engineering
Registration/Licence #	41859	**Jurisdiction of Registration**	BC and Alberta

Telephone Number: 403-560-7615 Email: jayne.nichols@fluor.com

If you are unable to act as a referee, please indicate the reason in the space provided:

1

Docs #71683

A. YOUR PERSONAL KNOWLEDGE OF THE APPLICANT

1. For how many years have you known the applicant:

Personally: N/A From (please provide dates) _____ to _____

Professionally: 17 years From (please provide dates) June 1998 to present

2. In your opinion, is the applicant's character:

■ Acceptable ☐ Not acceptable (please elaborate below)

B. YOUR PROFESSIONAL KNOWLEDGE OF THE APPLICANT

(Please provide additional comments which may assist the Registration Committee in its decision.)

1. What is or was your professional relationship to the applicant?

■ Supervisor ☐ Client ■ Colleague ■ Other (*please describe*)

I have worked with Barry for over 17 years. When I began at Fluor, he was a senior metallurgist in the same department that I worked in. He was group leader for Metallurgy and Welding and Piping Materials Engineering for several years, and I reported directly to him. In 2013, I became Department Manager for Mechanical Engineering, and Barry Messer is now a direct report of mine, who is a technical expert in his field.

2. have you been professionally associated with the applicant and for what period during this time, has the applicant been engaged in engineering or geoscience?

Yes, I worked with Barry during the 17 years in a professional capacity. Barry has been engaged in engineering throughout the 17 years.

3. In your opinion, are the applicant's English language skills related to the provision of engineering or geoscience services at a level sufficient to protect the interest of the public in British Columbia?

Speaking	■ Excellent	☐ Satisfactory	☐ Unsatisfactory
Writing	■ Excellent	☐ Satisfactory	☐ Unsatisfactory
Listening	■ Excellent	☐ Satisfactory	☐ Unsatisfactory
Reading	■ Excellent	☐ Satisfactory	☐ Unsatisfactory

Comments

Barry speaks and writes fluently with no accent.

4. In your opinion does the applicant

- apply engineering/geoscience principles in a knowledgeable and accurate manner? ■ Yes ☐ No

- possess sound professional judgment? ■ Yes ☐ No

Although I haven't assessed his worked when I was his direct report, in my experience with him he does possess sound professional judgement.

- have the ability to recognize and work within his/her limitations? ■ Yes ☐ No

Barry will reach out to others in the corporation if he needs a second opinion. He also is active in the Canadian Welding Bureau and will reach out to others in the industry if needed.

- adhere to APEGBC's Code of Ethics? ■ Yes ☐ No

C. YOUR ASSESSMENT OF THE APPLICANT'S EXPERIENCE

1. The purpose of the limited licence review process is to ascertain whether or not the applicant is ready to accept full professional responsibility for work performed and understands his/her limitations. Satisfactory experience involves the application of engineering or geoscience principles and theory, showing progression by evidence of increasing complexity and responsibility. It is requested that you review the enclosed summary of experience provided by the applicant and comment on its validity. Also, please emphasize any areas in which you judge the applicant to have gained outstanding experience. (Attach extra pages if necessary.) Please specify types of experience gained by the applicant ***relevant to the requested scope of licence***, and which you can confirm.

Barry Messer is a Fluor Senior Fellow, Technical Director and expert in Materials and Welding Engineering. He is known globally within Fluor and externally by clients and industry leaders as being an expert in this area. Barry assesses metallurgical and welding engineering challenges on a daily basis, and is able to make engineering judgements on the most complex equipment for energy, chemical and mining projects. Barry's experience, as outlined in the documents provided to me, is accurate to the best of my knowledge. Barry's level of knowledge is at an industry technical expert level, as demonstrated by his numerous professional publications and patents. Barry regularly participates in material selection, integrity analysis, in service failures and fabrication of equipment for Canadian and global projects.

2. You are asked to judge how much of the applicant's experience with which you are specifically familiar was:

Type of Experience	Duration (Number of years/months)	Dates	
		From (Month/Year)	To (Month/Year)
At a Non Technical Level			
Training/Familiarization			
At a Engineering/Geoscience Level			
At a Professional Level and Under Direct Supervision of a P.Eng/P.Geo	17 years / 10 months	June 1998	April 2016

3. In your judgment, is the applicant qualified by experience to practice at a **professional level within the scope of licensure requested?** If your answer is YES please be certain that the applicant can accept full professional responsibility including judging accurately when he/she is our of his/her depth.

■ Yes ☐ No (Please elaborate below)

D. **ADDITIONAL INFORMATION**

1. If you have any additional information which will assist in our evaluation, please provide it below:

2. If, for any reason, you believe that granting of Limited Licensure to the applicant should be withheld at this time, please comment below:

Signature	cn=NIC57142, email=Jayne.Nichols@fluor.com 2016.04.19 10:19:53 -08'00'	Date	19 April 2016

Please return this form, with a copy of the applicant's work experience summary, to:
APEGBC, 200-4010 Regent Street, Burnaby BC V5C 6N2, Canada
or Fax to 604-430-8085
Forms can also be emailed with applicants permission to register@apeg.bc.ca
THANK YOU FOR TAKING THE TIME TO PROVIDE THIS REFERENCE.

Registration

● **Policy** ○ **Procedure**

■ Special Consideration Clause (Engineers and Geoscientists)

PURPOSE

- To accommodate candidates with extensive engineering or geoscience experience but who do not satisfy the academic requirements of a regular application for registration, where the successful registration of these candidates benefits both the engineering or geoscience community and the public.

CREATED	BY:	Date:	Reference:
	COUNCIL	August 1994	APEGBC Registration Manual

POLICY:

"Special consideration may be given to an applicant:

a) who does not meet the formal education requirements but is generally recognized as being an expert in an engineering or geoscience specialty. Exemption from examinations or assignment of a special examination may be considered. Such consideration will be limited to applicants for registration who appear as isolated and exceptional cases. The decision will be made by the Council but no decision to grant registration/licence will be made before the application has come before two meetings of Council and 12 members have voted in favour of the application at the second meeting.

b) who has provided satisfactory evidence of being particularly well-qualified in a discipline of as judged by the depth and breadth of the academic education and engineering or geoscience experience. Such an applicant may be exempted from examinations in subjects required by the Uniform Syllabus but not relevant to the work being performed provided that other academic subjects were passed which are not required by the syllabus but are relevant to the work being performed."

CROSS REFERENCES

Current Policy

Registration

● Policy ❍ Procedure

Treatment of Applicants whose discipline of Practice/Experience is different from their discipline of Academic Qualification

PURPOSE

To address the theoretical knowledge required of applicants who choose to practice in a discipline of engineering or geoscience that is substantially different from their discipline of graduation; and to provide for a method of evaluation that takes into account the professional development, experience and competencies of the applicant.

CREATED

BY:	Date:	Reference:
COUNCIL	December 7, 2007	CO 08-21
	June 17, 2017	CO 16-58

POLICY

Applicants who are academically qualified in their discipline of engineering or geoscience studies, and whose current engineering or geoscience area of practice is different from their discipline of studies, will be assessed to determine whether they have bridged the gap between the engineering or geoscience fundamentals learned at the undergraduate level and engineering or geoscience fundamentals necessary to support their discipline of engineering or geoscience practice.

i. If an applicant for professional engineer or professional geoscientist registration/licence has completed a 'traditional' experience template with references, a detailed academic assessment will be conducted, followed by a Looking-to-Exempt interview.

ii. If an applicant for professional engineer registration/licence has completed a competency assessment, it will be used as the basis for the assessment.

PROCEDURE:

A. *Traditional Experience Report Plus References*

If the discipline of engineering or geoscience studies is different from the engineering or geoscience practice; and the applicant has completed a 'traditional' experience template with references, the assessment of the applicant must include the following two elements:

a) an assessment of the academic credentials in the discipline of practice to determine what syllabus topics have not been covered by the academic formation of the applicant and would normally require assignment of courses and/or an examination program; and
b) an assessment of the applicant through a Looking-to-Exempt type

Registration

● Policy ❍ Procedure

interview so the applicant can explain what additional courses, postgraduate degrees, employer-sponsored seminars/training and experience has been obtained in order to bridge the gap between the engineering or geoscience fundamentals learned at the undergraduate level and engineering or geoscience fundamentals necessary to support his/her discipline of engineering or geoscience practice.

The assessment may result in waiver of missing syllabus topics or the assignment of:

- specific courses or examinations;
- confirmatory examinations or the Fundamentals of Engineering Examination; and/or
- a report on an approved topic, and/or additional experience in the discipline in question.

B. *Competency-Based Assessment – Conditions Met*

If the applicant is applying for professional engineer registration/licence and their discipline of engineering studies is different from their engineering practice; and the applicant has:

a. submitted a competency-based assessment of his/her experience using APEGBC's Competency-Based Assessment system ,

b. all positive references

c. demonstrated at least four years of engineering experience

d. had his/her Technical Competencies validated by at least two validators in the applicant's discipline of practice;

e. all competency categories validated at the required level; and

f. achieved all competency categories at the required level in the opinion of two competency assessors;

the applicant will be brought to the Registration Committee for approval of academic and experience requirements for registration in the applicant's discipline of practice.

- If the applicant has not demonstrated at least one year or equivalent of engineering experience in a Canadian Environment, the assignment by the Registration Committee will be subject to gaining one year or equivalent of engineering experience in a Canadian

Registration

● Policy ❍ Procedure

Environment;

C. *Competency-Based Assessment – Conditions Not Met*

If the applicant has submitted a competency-based assessment of his/her experience using APEGBC's Competency-Based Assessment system, but has failed to meet the conditions outlined in a. through f. above:

the applicant will be required to have a detailed assessment of academic credentials followed by a Looking-to-Exempt interview as outlined in procedure A. above.

If professional competency guidelines exist for assessment of professional geoscience experience they will be used in the assessment of applicants for professional geoscience registration/licence.

See next page for Process Flowchart

CROSS-REFERENCES

APEGBC Policy 51993 *Engineering – All Disciplines - Minimum Academic Requirements for Registration*

Engineers and Geoscientists Act s.13 Admission to Membership

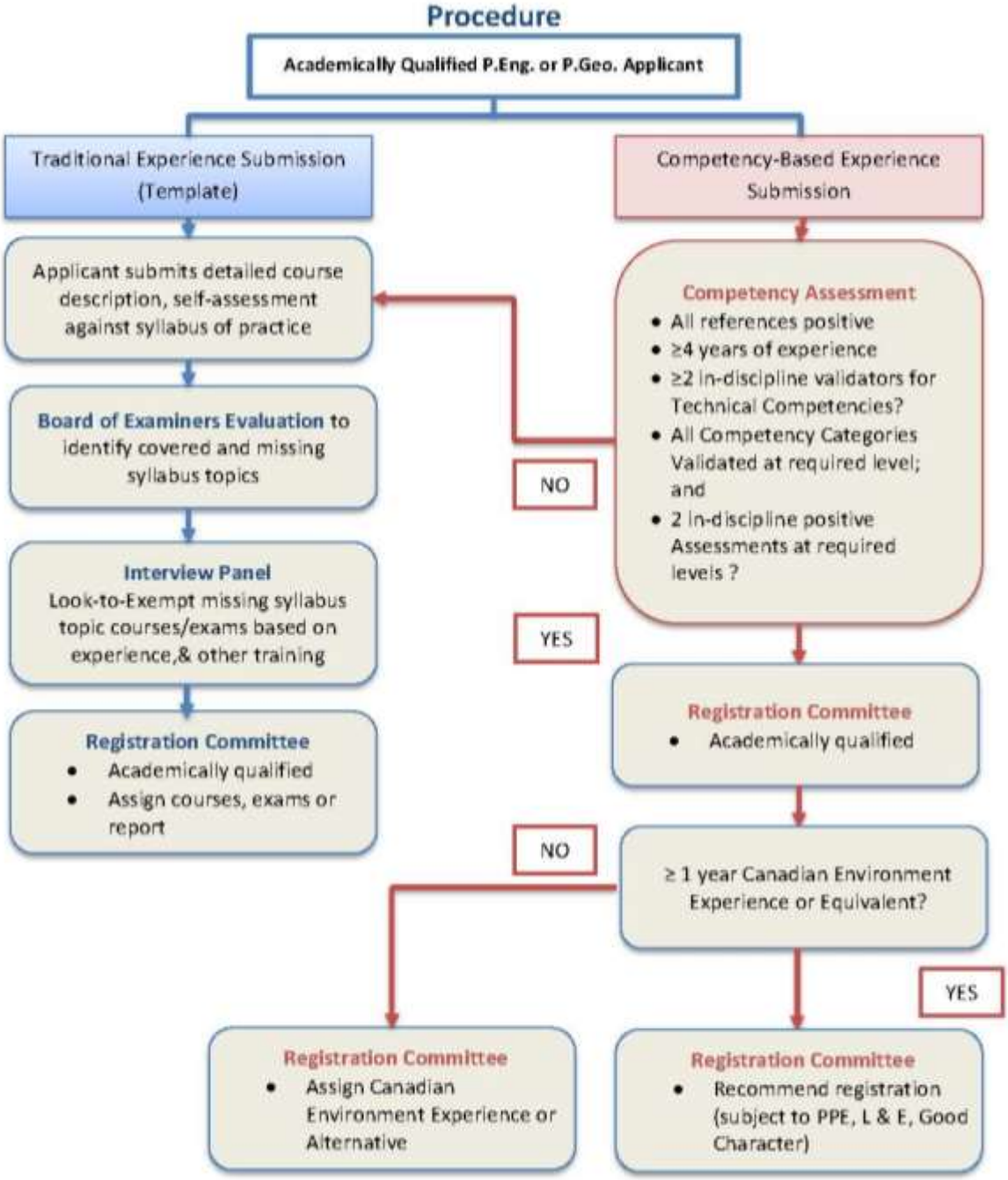
Bylaws of the Association s.11(e) Registered Members

APEGBC Policy re: *Screening of Looking-to-Exempt Interviewees*

Registration Committee meeting minutes of September 2011 (RG 11-252)

Registration

● Policy ❍ Procedure



Redlined Version with Proposed Policy Changes

Registration

● Policy ❍ Procedure

Treatment of Applicants whose discipline of Practice/Experience is different from their discipline of Academic Qualification

PURPOSE

To address the theoretical knowledge required of applicants who choose to practice in a discipline of engineering or geoscience that is substantially different from their discipline of graduation or who are in an inter-disciplinary field of practice; and to provide for a method of evaluation that takes into account the professional development, experience and competencies of the applicant.

CREATED

BY:	Date:	Reference:
COUNCIL	December 7, 2007	CO 08-21
	June 17, 2016	CO 16-58
	November 25, 2016	CO 17-XX

POLICY

Applicants who are academically qualified in their discipline of engineering or geoscience studies, and whose current engineering or geoscience area of practice is different from their discipline of studies, and applicants who are in inter-disciplinary field of practice; will be assessed to determine whether they have bridged the gap between the engineering or geoscience fundamentals learned at the undergraduate level and engineering or geoscience fundamentals necessary to support their discipline of engineering or geoscience practice.

i. If an applicant for professional engineer or professional geoscientist registration/licence has completed a 'traditional' experience template with references, a detailed academic assessment will be conducted, followed by a Looking-to-Exempt interview unless both members of the Experience Review Panel recommend registration and the applicant has all positive references. In this case the application will be taken to the Registration Committee for discussion.

ii. If an applicant for professional engineer registration/licence has completed a competency assessment, it will be used as the basis for the assessment.

PROCEDURE:

A. *Traditional Experience Report Plus References*

If the applicant is applying for professional engineer registration/licence and their discipline of engineering studies is different from their engineering practice, or the applicant is in an inter-disciplinary field of practice; and the applicant has:

a. all positive references

Registration

● Policy ❍ Procedure

b. demonstrated at least four years of engineering experience in the discipline of application

c. had his/her work experience supported by at least two references in the applicant's discipline of practice;

d. had two members of an experience review panel recommend registration;

the applicant will be brought to the Registration Committee for approval of academic and experience requirements for registration in the applicant's discipline of practice.

If the applicant does not meet the conditions listed above, the assessment of the applicant must include the following two elements:

a) an assessment of the academic credentials in the discipline of practice to determine what syllabus topics have not been covered by the academic formation of the applicant and would normally require assignment of courses and/or an examination program; and

b) an assessment of the applicant through a Looking-to-Exempt type interview so the applicant can explain what additional courses, postgraduate degrees, employer-sponsored seminars/training and experience has been obtained in order to bridge the gap between the engineering or geoscience fundamentals learned at the undergraduate level and engineering or geoscience fundamentals necessary to support his/her discipline of engineering or geoscience practice.

The assessment may result in waiver of missing syllabus topics or the assignment of:

- specific courses or examinations;
- confirmatory examinations or the Fundamentals of Engineering Examination; and/or
- a report on an approved topic, and/or additional experience in the discipline in question.

B. *Competency-Based Assessment – Conditions Met*

If the applicant is applying for professional engineer registration/licence and their discipline of engineering studies is different from their engineering practice, or the applicant is in an inter-disciplinary field of practice; and the applicant has:

a. submitted a competency-based assessment of his/her experience using APEGBC's Competency-Based

Registration

● Policy

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Assessment system ,

b. all positive references

c. demonstrated at least four years of engineering experience in the discipline of application

d. had his/her Technical Competencies validated by at least two validators in the applicant's discipline of practice;

e. all competency categories validated at the required level; and

f. achieved all competency categories at the required level in the opinion of two competency assessors;

the applicant will be brought to the Registration Committee for approval of academic and experience requirements for registration in the applicant's discipline of practice.

- If the applicant has not demonstrated at least one year or equivalent of engineering experience in a Canadian Environment, the assignment by the Registration Committee will be subject to gaining one year or equivalent of engineering experience in a Canadian Environment;

C. *Competency-Based Assessment – Conditions Not Met*

If the applicant has submitted a competency-based assessment of his/her experience using APEGBC's Competency-Based Assessment system, but has failed to meet the conditions outlined in Section B a. through f. above:

the applicant will be required to have a detailed assessment of academic credentials followed by a Looking-to-Exempt interview as outlined in procedure A. above.

If professional competency guidelines exist for assessment of professional geoscience experience they will be used in the assessment of applicants for professional geoscience registration/licence.

See next page for Process Flowchart

Redlined Version with Proposed Policy Changes

Registration

● Policy ❍ Procedure

CROSS-REFERENCES

APEGBC Policy 51993 *Engineering – All Disciplines - Minimum Academic Requirements for Registration*

Engineers and Geoscientists Act s.13 Admission to Membership

Bylaws of the Association s.11(e) Registered Members

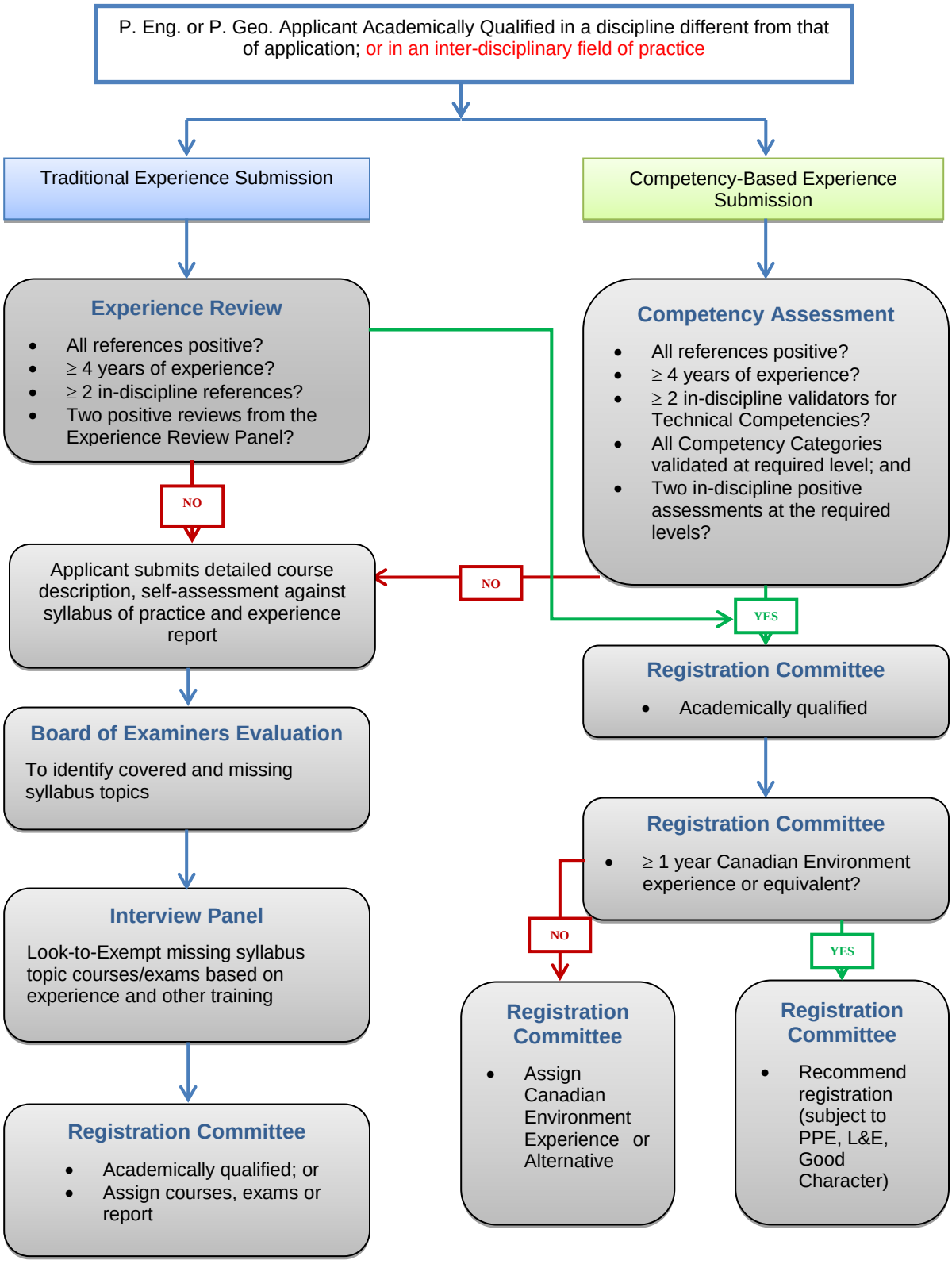
APEGBC Policy re: *Screening of Looking-to-Exempt Interviewees*

Registration Committee meeting minutes of September 2011 (RG 11-252)

Redlined Version with Proposed Policy Changes

Registration

● Policy ❍ Procedure



Clean Version of Policy with Proposed Changes

Registration

● **Policy** ❍ **Procedure**

Selection and Training of Registration Volunteers and Staff

PURPOSE

Volunteer training and allocation of adequate resources to this training is essential to ensure fair, equitable and consistent application of the Act and Bylaws and Registration Policies.

CREATED

BY:	Date:	Reference:
COUNCIL	December 7, 2007	CO 08-21
COUNCIL	September 14, 2012	CO 12-111[1]
COUNCIL	November 27, 2015	CO 16-10
COUNCIL	November 25, 2016	CO 17-

POLICY:

The Act and Bylaws will be applied in a manner that is fair and equitable. Experience Review Panel members, Competency Assessors, Reviewers, Interviewers, the Registration Committee and others responsible for making recommendations on the qualification of applicants for registration will follow a predictable and uniform approach to evaluation of applicants according to APEGBC policies and internal procedures

APEGBC staff and volunteers will be given adequate training to ensure they are qualified and knowledgeable of legislation, policies and procedures affecting the registration process, the applicants they are evaluating, and the environment in which they are operating.

Experience Review Panel members including Competency Assessors and EIT/GIT online reviewers will be professional engineers, professional geoscientists, or engineering or geoscience licensees registered or licensed in a Canadian jurisdiction. They should have, at a minimum:

a. five years of experience as a professional engineer or professional geoscientist or engineering or geoscience licensee in their stated field or scope of practice; and

b. completed appropriate training in the conduct of experience reviews (including competency assessments)and the application of APEGBC policy.

Interviewers should also have, at a minimum:

a. five years of experience as a professional engineer or professional geoscientist or engineering or geoscience licensee in their stated field or

[11] Consequential change re: renaming of Applications Committee to Experience Review Panel

scope of practice;

b. acted as observer/interviewer at least two interviews prior to acting as a primary interviewer or chair of an interview; and

c. completed appropriate training in the conduct of experience reviews (including competency assessments)and the application of APEGBC policy.

APEGBC will allocate sufficient staff, information technology, trainer and training support resources to ensure compliance with this policy.

Redlined Version of Policy with Proposed Changes

Registration

● **Policy** ❍ **Procedure**

Selection and Training of Registration Volunteers and Staff

PURPOSE

Volunteer training and allocation of adequate resources to this training is essential to ensure fair, equitable and consistent application of the Act and Bylaws and Registration Policies.

CREATED

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POLICY:

The Act and Bylaws will be applied in a manner that is fair and equitable. Experience Review Panel members, ~~including~~ Competency Assessors, Reviewers, Interviewers, the Registration Committee and others responsible for making recommendations on the qualification of applicants for registration will follow a predictable and uniform approach to evaluation of applicants according to APEGBC policies and internal procedures

APEGBC staff and volunteers will be given adequate training to ensure they are qualified and knowledgeable of legislation, policies and procedures affecting the registration process, the applicants they are evaluating, and the environment in which they are operating.

Experience Review Panel members including Competency Assessors and EIT/GIT online reviewers will be professional engineers, professional geoscientists, or engineering or geoscience licensees registered or licensed in a Canadian jurisdiction. They should have, at a minimum:

a. ~~,~~ five years of experience as a professional engineer or professional geoscientist or engineering or geoscience licensee in their stated field or scope of practice;and

b. ~~and have attended~~ completed appropriate training in the conduct of experience reviews (including competency assessments)~~;~~ and the application of APEGBC policy.

[11] Consequential change re: renaming of Applications Committee to Experience Review Panel

Registration

● Policy ❍ Procedure

Interviewers should also have, at a minimum:

a. ~~,~~ five years of experience as a professional engineer or professional geoscientist or engineering or geoscience licensee in their stated field or scope of practice;

b. ~~should have~~ acted as observer/interviewer~~s~~ at least two interviews prior to acting as a primary interviewer or chair of an interview; and

~~a.~~c. completed appropriate training in the conduct of experience reviews (including competency assessments)and the application of APEGBC policy.

APEGBC will allocate sufficient staff, information technology, trainer and training support resources to ensure compliance with this policy.

Professional Practice Guidelines - Legislated Dam Safety Reviews in BC

Professional Engineers and Geoscientists of BC

www.apeg.bc.ca

V3.0 Revised Oct 2016
V2.0 Revised March, 2014
Original July, 2013

TABLE OF CONTENTS

PREFACE

These *Professional Practice Guidelines - Legislated Dam Safety Reviews in BC* were initially commissioned by the British Columbia Ministry of Forests, Lands and Natural Resource Operations. The British Columbia Ministry of Energy and Mines then provided additional assistance so the guidelines would also address *dam safety reviews* for mining *dams*. They have been written with the intention of guiding professional practice for legislated *dam safety reviews* pursuant to *Dam Safety Regulation* 40/2016.

An appropriate standard of care in professional practice, when carrying out legislated *dam safety reviews,* is common to various types of dams. These guidelines provide the basis for an appropriate professional standard of practice when performing *dam safety reviews*. Appendix B (water reservoir *dams*) and C (mining *dams*) outline the specific aspects of *dam safety reviews* relevant to the governing legislation depending upon the purpose of the *dam* involved.

The objective of the legislation regulating *dams* in BC is to mitigate the potential loss of life and damage to property and the environment from a *dam* breach by requiring *dam owners* to: inspect their *dams*, undertake proper maintenance, report incidents and take remedial action and ensure that the *dams* meet current engineering standards by undertaking *dam safety reviews*. In their on-going effort to achieve these objectives, the two Ministries referenced above have played a leadership role in working with the *APEGBC* to develop these guidelines for legislated *dam safety reviews*. The development of these guidelines is consistent with one of the primary objectives of *APEGBC* which is to establish, maintain and enforce good practice of professionals regulated by *APEGBC*.

DEFINITIONS

The following definitions are specific to these guidelines.

Agreement
A contract or terms of engagement, whether formal (written) or informal (verbal or implied), between the *client* and the *Qualified Professional Engineer*, or his/her company, for conducting a *dam safety review.*

APEGBC
The Association of Professional Engineers and Geoscientists of British Columbia

Dam Safety Regulation
British Columbia Regulation 40/2016

CDA Dam Safety Guidelines
The *Dam Safety Guidelines* published by the Canadian Dam Association in 2007 (revised 2013) and associated Technical Bulletins referenced in these guidelines.

Classification
The *dam* failure consequence *classification* of a *dam* as determined by Schedule 1 of the *Dam Safety Regulation (*for water reservoir *dams*), or Table 2-1 of the *CDA Dam Safety Guidelines* (for *dams* under the *Mines Act*).

Client
An individual or company who engages a *Qualified Professional Engineer* to conduct a *dam safety review.* The *client* is typically the *dam owner* or a third party who has been contracted to operate and maintain the *dam* on behalf of the *dam owner*. In this instance, the *client* may be the organization acting on behalf of the *dam owner*. Multiple holders of water licenses and therefore *owners* are common for small *dams*. In such cases, it is recommended that the *dam safety review* be undertaken with the *agreement* of the joint-owners or their appointed representatives, preferably authorized through a Joint Works Agreement between the *owners*.

Dam
A barrier constructed across a stream or river, or a barrier constructed off-stream and supplied by a diversion of water from a stream or an aquifer, for the purposes of enabling the storage or diversion of water, and including all works which are incidental to and necessary for the barrier. With respect to water reservoir *dams*, these guidelines only apply to *dams* whose size equals or exceeds the size given in Section 2 of the *Dam Safety Regulation* or has a *classification* of significant, high, very high or extreme*.*

Such a *dam* does not include any power production facility or water draw-off facility that is not directly connected to the *dam* as defined above and does not form an integral part of the barrier across the stream or river.

It also includes retaining structures that exist at mine sites or metallurgical plant sites that retain solids (that may be contaminated) and/or contaminated liquids and are regulated under the *Mines Act*. These retaining structures may include tailing *dams* and sludge storage *dams*.

Dam safety analysis
The *dam safety analysis* is the technical activity within a *dam safety review* which is carried out to identify the variety of threats to the performance and functional integrity of a *dam* which ultimately could place various elements at risk (e.g. people, property, the environment). Determination of what is the acceptable level of risk or safety for the various elements which are identified as being at risk is not the role of the *Qualified Professional Engineer* and is outside the scope of the *dam safety analysis*.

Dam safety review
A legislated periodic review of the safety assessment of water reservoir *dams* that have a *classification* of high, very high or extreme, as defined by the *Dam Safety Regulation*, carried out by a *Qualified Professional Engineer* in accordance with the requirements of Section 20~~7~~ or Section 36 (4) of the *Dam Safety Regulation*. *Dam safety reviews* are also required ~~for all water storage facilities and~~ for tailings storage facilities at least every five years ~~*dams*~~ under the *Mines Act and* in accordance with the *CDA Dam Safety Guidelines*.

Dam Safety Review Assurance Statement
The statement for submission, along with the *dam safety review report*, to the *regulatory authority,* to fulfill the *dam owner's* obligations in accordance with Section 20 or Section 36 (4) of the *Dam Safety Regulation*, or Permit Conditions under the *Mines Act*. Two assurance statements are attached as Appendices D1 and D2 to these guidelines.

Dam safety review report
A report prepared by the *Qualified Professional Engineer* for the *client*, for submission to the *regulatory authority* in accordance with Section 20 or Section 36 (4) of the *Dam Safety Regulation*.

Design Engineer

Formatted: Font: Bold

The Professional Engineer having overall responsibility for the design of the dam which includes responsibility for developing and overseeing the site characterization of the dam's foundation. The Design Engineer signs the site characterization assurance statement required in support of the feasibility study (see Appendix A of the APEGBC Professional Practice Guidelines – Site Characterization for Dam Foundations in BC). The Design Engineer would normally transition into the Engineer of Record.

Engineer of Record (EOR)

Formatted: Font: Bold

The Professional Engineer responsible for assuring that the dam is safe, in that it is designed and constructed in accordance with the current state of practice and applicable regulations, statues, guidelines, codes and standards.

Engineers and Geoscientist Act
Engineers and Geoscientist Act, R.S.B.C. 1996, Chapter 116, as amended.

Member(s)
Professional Engineer or *Professional Geoscientist*. A *member* of *the Association of Professional Engineers and Geoscientists of British Columbia*.

Mines Act
Mines Act R.S.B.C., 1996 c. 293 (Updated to 2007)

Ministry
British Columbia Ministry of Forests, Lands and Natural Resource Operations (water reservoir *dams*) or the British Columbia Ministry of Energy and Mines (mining *dams*) depending upon the nature of the *dam* involved.

Owner/Dam Owner
A person or legal entity, who with respect to the *dam*, is any of all of the following: (a) the person or legal entity who holds the current licence or is required to hold a licence for the *dam*; (b) the person or legal entity who last held a licence for the *dam*, including a licence that has been suspended, cancelled, abandoned or terminated; (c) if there is no person or legal entity to whom paragraph (a) and (b) above applies, the *owner* of land on which the *dam* is located or the person or legal entity who had the *dam* constructed.

Professional Engineer
An engineer who is a *member* or licensee in good standing with *APEGBC* and for the purposes of these guidelines is typically registered in the disciplines of structural, civil, geological or mining engineering, which are designated disciplines of professional engineering.

Professional Geoscientist
A geoscientist who is registered or licensed *member* in good standing with *APEGBC* and typically is registered in the disciplines of geology or environmental geoscience, which are designated disciplines of professional geoscience.

Qualified Professional Engineer
A *professional engineer member* or licensee in good standing with *APEGBC,* and for the purposes of these guidelines, is typically registered in the disciplines of structural, civil, geological or mining engineering with the appropriate level of education, training and experience, as defined by these guidelines, to conduct *dam safety reviews* as described in these guidelines.

Regulatory Authority
The *regulatory authority* is the department within the British Columbia Ministry of Forests, Lands and Natural Resource Operations (freshwater reservoir *dams*) or the British Columbia Ministry of Energy and Mines (mining *dams*) depending upon the nature of the *dam* involved that is tasked with managing the regulatory requirements of *dam* safety, as enacted by statutes and regulations of British Columbia.

1.0 INTRODUCTION

INTRODUCTION TO THE GUIDELINES

Dams in British Columbia may be owned by diverse parties including utilities, mining companies, pulp and paper companies, various levels of government, including first nations or private *owners*. Provincial legislation requires that *dam safety reviews* be carried out by a *professional engineer* "qualified in *dam safety analysis*". *Qualified professional engineers* with the appropriate education, training and experience have the technical ability to carry out various forms of *dam safety reviews* including *dam safety analysis*. The legislation requires that a *Qualified Professional Engineer* provides their professional opinion regarding the safety status of the *dam*.

This professional opinion regarding the safety status of the *dam* has a time limitation pursuant to the *Dam Safety Regulation*. Under such circumstances the *dam safety review* can be considered to be a "snapshot in time", the validity of which is specified in the *dam safety review report*. Notwithstanding the requirements of the *Dam Safety Regulation* with respect to the interval between reviews, it may be concluded for engineering reasons that the professional opinion is valid for a shorter time.

These guidelines do not consider the impacts of climate change on the safety status of the *dam* within the period for which the professional opinion is valid. This is because climate change is a time-varying process over decades and centuries, the duration of which is such that significant changes in key design parameters such as the "design flood" as a consequence of climate change will not change during the period of validity of the *dam safety review*.

The Canadian Dam Association (CDA) *Dam Safety Guidelines* as well as their associated technical bulletins and bulletins and guidelines issued by the International Commission on Large Dams (ICOLD) are referenced throughout these guidelines. These documents are resources which provide accepted practices for the determination of the currency and adequacy of the physical performance capacity of a *dam* and the management of the operational integrity of a *dam*.

The Ministries and *APEGBC* assembled a team of specialists from government and the engineering community to prepare these guidelines. The application of these guidelines will result in consistent and comprehensive *dam safety review reports* being submitted to *dam owners* and the *regulatory authority*.

Specific objectives of these guidelines are to:

(i) outline the professional services that should generally be provided by *Qualified Professional Engineers* conducting *dam safety reviews*;

(ii) describe the standard of care a *Qualified Professional Engineer* should follow in providing professional services in the field of *dam safety reviews*;

(iii) specify the tasks that should be performed by a *Qualified Professional Engineer* to meet an appropriate standard of care when preparing *dam safety review reports*, and which fulfills the *Qualified Professional Engineer's* professional obligations under the *Engineers and Geoscientists Act*. These obligations include the *Qualified Professional Engineer's* primary duty to protect the safety, health and welfare of the public and the environment;

(iv) describe the roles and responsibilities of the various participants/stakeholders involved in *dam safety reviews*. The document will assist in delineating the roles and responsibilities of the various participants/stakeholders;

(v) identify various concepts that can be used in risk informed *dam* safety decision making;

(vi) provide consistency in *dam safety review reports* and other documents prepared by a *Qualified Professional Engineer* when providing professional services in this field of *dam safety reviews*; and

(vii) describe the appropriate knowledge, skill sets and experience that *Qualified Professional Engineers* should have who are providing *dam safety review* services.

1.1 PURPOSE OF THESE GUIDELINES

This document provides guidelines of professional practice for a *Qualified Professional Engineer* who carries out a *dam safety review* in response to legislation in BC. Appendix D to these guidelines provides two separate *Dam Safety Review Assurance Statements* one of which must be submitted, along with a *dam safety review report*, to a *dam owner* and the relevant *regulatory authority*. Appendix D1 contains the *Dam Safety Review Assurance Statement for Water Reservoir Dams* and is to be submitted in conjunction with the *dam safety review report* for the purposes of the *Dam Safety Regulation*. Appendix D2 contains the *Dam Safety Review Assurance Statement for Mining Dams* and is to be submitted with the dam safety reports in response to permit conditions under the *Mines Act*.

These guidelines address typical project organization and responsibilities of the various participants/stakeholders; professional practices that should typically be provided; quality assurance/quality control; and professional registration and education, training and experience.

1.2 ROLE OF *APEGBC*

These guidelines have been formally adopted by the Council of *APEGBC*, and form part of *APEGBC's* ongoing commitment to maintaining the quality of services *members* and licensees provide to their *clients* and the general public. *Members* and licensees are professionally accountable for their work under the *Engineers and Geoscientists Act*, which is enforced by *APEGBC*.

A *Qualified Professional Engineer* must exercise professional judgment when providing professional services; as such, application of these guidelines will vary depending on the circumstances. *APEGBC* supports the principle that a *member* should receive fair and adequate compensation for professional services, including services provided to comply with these guidelines. An insufficient fee does not justify services that do not meet the intent of these guidelines. These guidelines may be used to assist in establishing the objectives, type of *dam safety reviews*, level of service and terms of reference of a *Qualified Professional Engineer's agreement* with the *client*.

By following these guidelines a *Qualified Professional Engineer* will fulfill his/her professional obligations, especially with regards to *APEGBC* Code of Ethics Principle 1 (hold paramount the safety, health and welfare of the public, protection of the

environment and promote health and safety in the workplace[1]). Failure of a *Qualified Professional Engineer* to meet the intent of these guidelines could be evidence of unprofessional conduct and lead to disciplinary proceedings by *APEGBC*.

1.3 INTRODUCTION OF TERMS

For the purpose of these guidelines, a *Qualified Professional Engineer* is a *professional engineer* with the appropriate education training and experience to carry out *dam safety reviews* including *dam safety analysis* as described in these guidelines (refer to Section 5). Typically, a *Qualified Professional Engineer* will be trained and ~~practising~~practicing in the discipline of structural, civil, geological or mining engineering, and have knowledge of the interdependencies between these disciplines relevant to the performance of *dams*.

The Engineer of Record (EOR) is a professional engineer retained by the owner, who is responsible for assuring that the dam is safe, in that it is designed and constructed in accordance with the current state of practice and applicable regulations, statues, guidelines, codes and standards. The EOR is a requirement for mining dams in BC and may be in place for other dams in BC. If there is an EOR engaged, then they should be engaged during the dam safety review process and should review all dam safety review reports.

A *dam safety review report* is an assessment of the safety status of a *dam* based on data, analysis and professional engineering interpretation, in accordance with the generally accepted engineering practices involved in the determination of the currency and adequacy of the physical performance capacity of a *dam* and the management of the operational integrity of a *dam*.

Dam safety analysis is a combination of firstly, consideration of hazards, failure modes and failure mechanisms, and secondly, consideration of consequences of functional failure of a *dam*.

1.4 SCOPE OF THE GUIDELINES

These guidelines apply to *dam safety review reports* prepared in response to the *Dam Safety Regulation* (refer to Appendix A: Legislative Framework – Water Reservoir Dams). These guidelines also apply to *dam safety review reports* for mining *dams* prepared in response to permit conditions under the *Mines Act* (refer to Appendix B: Mining Dams – Considerations in Dam Safety Reviews)

It is recognized that *dam safety reviews* may be carried out for purposes other than in response to the above referenced legislation. While these guidelines were not intended to address such non-legislated~~ive~~ *dam safety reviews* some of the information contained in these guidelines may be relevant to the preparation of such non-legislated *dam safety review reports*.

Furthermore, *dam safety reviews* as documented in these guidelines are not intended to address any Occupational Health and Safety requirements in relation to *dams* although where a serious concern is identified, it must be brought to the attention of the *dam owner/Client*.

[1] *APEGBC's* Code of Ethics is at https://www.apeg.bc.ca/APEGBC/media/APEGBC/Governance/APEGBC-Code-of-Ethics.pdf. The Code of Ethics, along with accompanying Guidelines and Commentary, are published in the current (1994) edition of *APEGBC's* "Guidelines for Professional Excellence".

1.5 APPLICABILITY OF THE GUIDELINES

Notwithstanding the purpose and scope of these guidelines, a *Qualified Professional Engineer's* decision not to follow one or more aspects of these guidelines does not necessarily mean that he/she has failed to meet his/her professional obligations. Such judgments and decisions depend upon weighing facts and circumstances to determine whether another reasonable and prudent *Qualified Professional Engineer*, in a similar situation and during the same time frame, would have conducted himself/herself similarly.

Although the *client* is often the *owner* of a *dam*, a *dam safety review* can also be carried out at the request of the *regulatory authority*. Following these guidelines, however, does not ensure that the conclusions and recommendations contained within the *dam safety review report* will be accepted by the *regulatory authority.*

These guidelines are influenced by current provincial legislation, current case law, advances in knowledge, and evolution of general professional practices in British Columbia. As such, they may require updating from time to time.

1.6 ACKNOWLEDGMENTS

These guidelines were prepared on behalf of *APEGBC* by a Committee of *Qualified Professional Engineers* and were reviewed by several diverse parties and stakeholders as members of a Review Task Force. The authors and reviewers are listed in Appendix ~~J~~I. The authors thank the reviewers for their constructive suggestions. A review of this document does not necessarily indicate the reviewer and/or his employer endorses everything in the document.

APEGBC thanks the BC Ministry of Forests, Lands and Natural Resource Operations and the BC Ministry of Energy and Mines as they not only funded the preparation of these guidelines but provided technical and administrative support.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 COMMON FORMS OF PROJECT ORGANIZATION

The *dam owner* has the responsibility for carrying out *dam safety reviews* on their *dams* with certain *classifications* and at the intervals provided in the *Dam Safety Regulation* (for water reservoir dams) or the *CDA Dam Safety Guidelines* (for mining *dams* required under the *Mines Act)*. *Dam owners* are required to comply with this legislation by having a *Qualified Professional Engineer* carry out a *dam safety review*. The *Qualified Professional Engineer* will prepare a *dam safety review report* for the *dam owner*. The *dam owner* will then submit a copy of the *dam safety review report* to the *regulatory authority* for acceptance.

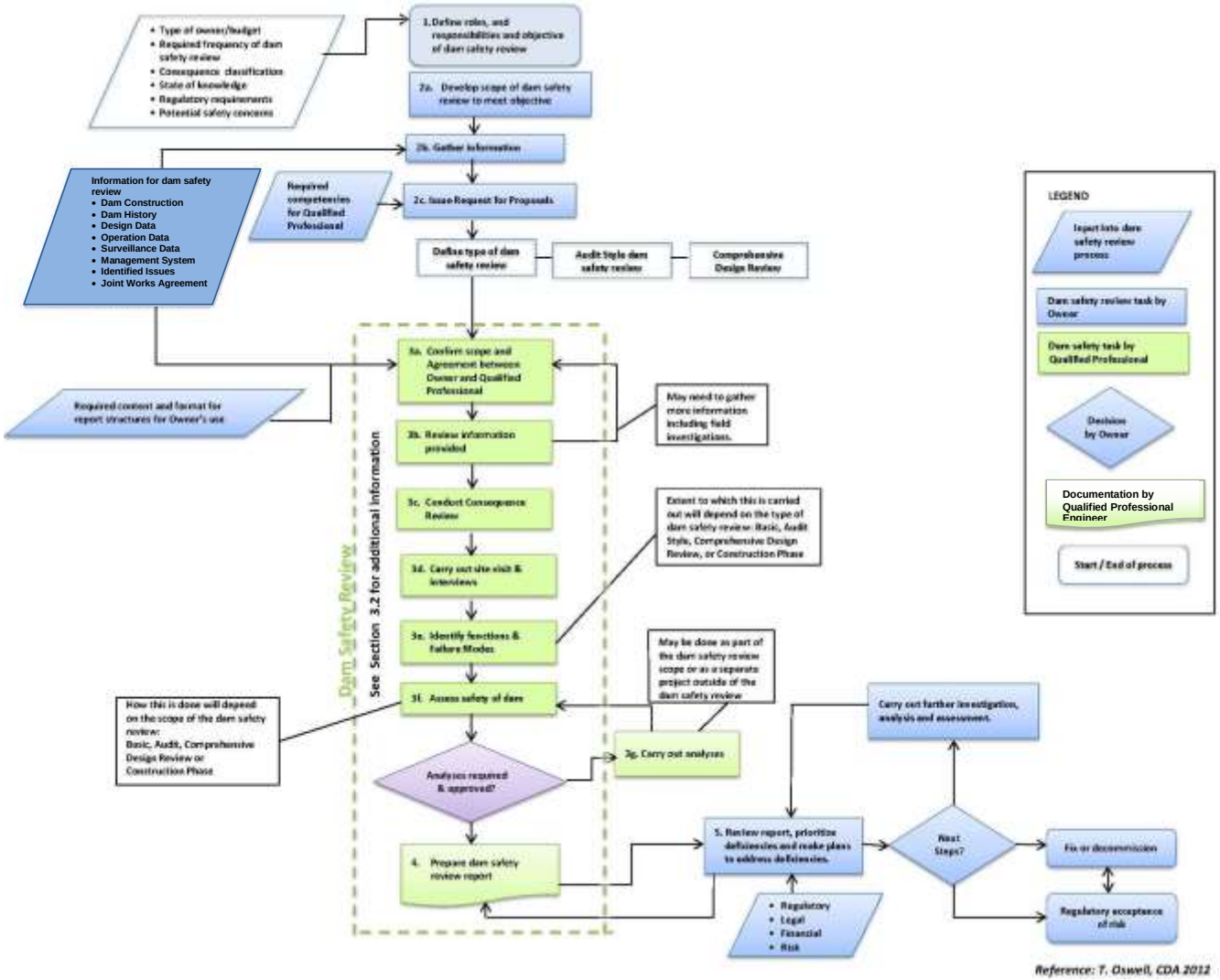
Typically the *dam owner* or the operator of the *dam*, on behalf of the *dam owner*, is the *client* and the *Qualified Professional Engineer* establishes an *agreement* for professional services with that party. The *Qualified Professional Engineer* must be aware that his/her *dam safety review report* will ultimately be reviewed by the *regulatory authority*.

The *client* should be aware that the *Qualified Professional Engineer* may find that the *dam* is not safely operated, and is then required to make recommendations in the *dam safety review report* as to the actions that are required to rectify the deficiencies or non-conformances identified. In such a case, the *client* is required to prepare a plan that identifies and prioritizes any actions required to correct the potential *dam* safety hazard and submit the plan to the *regulatory authority*.

The *Qualified Professional Engineer* should ensure that his/her role, in relation to the *client* and *regulatory authority*, is clearly defined. It is possible that a *client* may not have previously been involved in *dam* safety, nor previously engaged a *Qualified Professional Engineer*. In addition, the *client* may not fully understand or appreciate the level of effort required by the *Qualified Professional Engineer* to conduct the *dam safety review* on a particular *dam*. The amount of data and previous analyses that are available to the *Qualified Professional Engineer* for conducting the *dam safety review* may significantly influence the level of service required for the *dam safety review*. Therefore, the *Qualified Professional Engineer* should review with the *client* the typical responsibilities listed below, to assist in establishing an appropriate *agreement* for professional services and to inform the *client* of the expectation of appropriate and adequate compensation (*APEGBC* Code of Ethics Principle 5).

Details of a *dam safety review* are included in Section 3, however, all parties (*Client, regulatory authority* and *Qualified Professional Engineer*) should understand that the scope of the *dam safety review* lies within a larger *dam* safety management framework.~~,~~ ~~as depicted below, which provides context to the *dam safety review* process.~~ Figure 1 presents a flow chart of the typical activities involved in initiating a *dam safety review* process and conducting the review as well as how the *dam safety review* fits within the *dam* safety management framework. Some of the activities illustrated might be sequenced slightly differently (e.g. CDA, 2016) without altering the general intent or content of the Dam Safety Review.

Figure 1: *Dam Safety Review* Process



Reference: T. Oswell, CDA 2012

2.2 RESPONSIBILITIES

Sections 2.2.1 to 2.2.3 describe some of the typical responsibilities of a *client*, *Qualified Professional Engineer* and the *regulatory authority*. Section 2.2.4 describes some of the typical responsibilities of a *Qualified Professional Engineer* when asked by the *regulatory authority* or *client* to review a *dam safety review report* prepared by another *Qualified Professional Engineer*.

2.2.1 The *Client*/*Dam Owner*

Prior to the *dam safety review*, the *client* should know the current *classification* of the *dam. Dam owners* should be aware of the legislative requirements associated with the operation and maintenance of the *dam*, as set out in the *Dam Safety Regulation* and the *Heath, Safety and Reclamation Code*. In some cases, the *client* may not be aware of the need to classify the *dam* in terms of the consequences of failure. In that case the *client* should contact the *regulatory authority*. Further, the *dam owner* should contact the *regulatory authority* to clarify any uncertainties about their legislative responsibilities under the *Dam Safety Regulation* or under their permit conditions required under the *Mines Act*.

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Typically, the *client* issues a request for proposals to either individual *Qualified Professional Engineers* or consulting engineering firms who have *Qualified Professional Engineers* on their staff. In some cases, the *client* may elect to negotiate directly with a *Qualified Professional Engineer* or a firm with *Qualified Professional Engineers* to conduct the *dam safety review*.

2.2.1.1 Guidance on Preparing Requests for Proposals

Prior to the issue of a request for proposals by the *client* for qualified professional engineering services for the *dam safety review*, it is helpful and will likely reduce the cost of professional services if the *client* is knowledgeable about the *dam* design and *dam* safety history as documented in various sources which are referenced in Section 3.

The *client* may not have sufficient knowledge in connection with *dam* safety to judge whether the content of the documents available for the *dam safety review*, contain the relevant information. In this case, it is recommended that the *client* consult with a *Qualified Professional Engineer* to determine whether the documents available for the review, are relevant or not. Alternatively, all the information available to the *client* should be provided to the *Qualified Professional Engineer* who will determine what documentation is relevant and what further documentation, if any, is required.

The *Qualified Professional Engineer's* scope of services for the *dam safety review* may vary from *dam* to *dam*, depending on the *classification* of the *dam* and records available for the review. For a *dam's* first *dam safety review*, the pertinent design records may not be available and the scope of services for the *dam safety review* may include in depth analyses to provide the level of detail for the *dam safety review* that is sufficient to demonstrate the safety of the *dam* structure and that it is being safely operated, maintained and monitored. For the first *dam safety review*, all the available data should be assembled and supplemented with any investigations and design analyses that have been carried out, as appropriate. After the first *dam safety review* for a particular *dam*, subsequent *dam safety reviews* are normally less costly and time-consuming as the original available data should have been assembled and supplemented by the investigations and analyses carried out during the first *dam safety review*. Subsequent *dam safety reviews* can be structured more as an audit of the previous information and

data generated since the previous *dam safety review*, to determine whether the *dam* is being safely operated. Input from the relevant *regulatory authority* should be sought at this stage so that the *regulatory authority* is supportive of the type of submission being prepared.

The scope of the *dam safety review* should be described in the request for proposals. The scope of work should be written to reflect the state of knowledge of the design, construction, operation, maintenance and surveillance of the particular *dam*. For an old *dam* which has not had any prior *dam safety reviews*, the scope of services will be more extensive than for a relatively new *dam* with extensive recent design and construction documentation. Similarly, the scope of services for the *dam safety review* of a *dam* with a straightforward layout on good foundations will be less extensive than the scope of services for the *dam safety review* of a *dam* with a complex layout on poor foundations.

The scope of work described in the proposal should assume that the *classification* of the *dam* remains unchanged during the *dam safety review*. If, during the Evaluation Phase of the *dam safety review* (see Section 3.2), the *Qualified Professional Engineer* determines that the *classification* of the *dam* should be reviewed and amended, the level of services required to carry out the *dam safety review* may increase from that originally assumed at the proposal stage and the *agreement* between the *client* and the *Qualified Professional Engineer* will be adjusted accordingly.

2.2.1.2 *Client*/*Qualified Professional Engineer* Involvement

It is recommended that the *client* select the *Qualified Professional Engineer* on their qualifications, availability, and local knowledge using a qualifications-based selection process.

Once the *client* has selected a *Qualified Professional Engineer* to conduct the *dam safety review*, the *client*, with assistance from the *Qualified Professional Engineer*, should complete a written *agreement* with the *Qualified Professional Engineer* confirming scope of work, schedule and cost estimate for the *dam safety review*, need for and scope of specialty services and need for external peer review. It is recommended that such an *agreement* include a clause that deals with potential disclosure issues due to the *Qualified Professional Engineer's* obligation under *APEGBC* Code of Ethics Principle 1 (hold paramount the safety, health and welfare of the public, the protection of the environment, and promote health and safety in the workplace). See Section 2.2.2 for further information.

The *client* should be aware that the *Qualified Professional Engineer's* scope of work and cost estimate may have to be amended during the assessment, depending on the *Qualified Professional Engineer's* findings and analysis. The cost estimate should be discussed and agreed to with the *client* prior to the assignment.

During the *dam safety review*, it is necessary for the *client* to provide the necessary background information for the *Qualified Professional Engineer* to conduct the *dam safety review*, as outlined in Section 3.3 and to provide the required access to the *dam* and all related facilities to enable the *Qualified Professional Engineer* to conduct the field work for the *dam safety review*.

After the *dam safety review*, it is important that the *client* reviews the *dam safety review report* and understands the conclusions and recommendations, and discusses the *dam safety review report* with the *Qualified Professional Engineer*. The *client* is required,

upon receipt of the final *dam safety review report,* to submit the *dam safety review report* to the *regulatory authority*.

It is recommended that the *agreement* between the *client* and the *Qualified Professional Engineer* address document ownership issues including those related to the *Dam Safety Review Assurance Statement* and the *dam safety review report* and the payment of the *Qualified Professional Engineer's* outstanding invoices by the *client*.

2.2.2 The *Qualified Professional Engineer*

The *dam safety review* must be carried out by a *Qualified Professional Engineer* or a multidisciplinary team which includes *APEGBC members* ~~and~~ who report~~s~~ to the lead *Qualified Professional Engineer.* The *Qualified Professional Engineer's* expected registration, education, training and experience are detailed in Section 5.0 of these guidelines. The *Qualified Professional Engineer* is responsible for the final *dam safety review report* and completes the *Dam Safety Review Assurance Statement*.

During the development of the *agreement* with the *Client*, it is recommended that a clause should be included into the *agreement* that deals with potential disclosure issues due to the *Qualified Professional Engineer's* obligation under *APEGBC* Code of Ethics Principle 1 (hold paramount the safety, health and welfare of the public, the protection of the environment, and promote health and safety in the workplace). The following is suggested wording for such a clause:

> *"Subject to the following, the Qualified Professional Engineer will keep confidential all information, including documents, correspondence, reports and opinions, unless disclosure is authorized by the Client. However, in keeping with APEGBC's Code of Ethics, if the Qualified Professional Engineer discovers or determines that there is a material risk to the environment or the safety, health and welfare of the public or worker safety, he/she shall notify the Client as soon as practicable of this information and the need for that information to be disclosed to the appropriate parties within a reasonable time. If the Client does not take the necessary steps to notify the appropriate parties within a reasonable amount of time, the Qualified Professional Engineer shall have the right to disclose that information to the appropriate parties in order to fulfil his/her ethical duties and the client hereby authorizes that disclosure."*

The *Qualified Professional Engineer* must comply with the requirements of *APEGBC* Bylaw 17 regarding professional liability insurance.

During the *dam safety review* the *Qualified Professional Engineer* must:

- if necessary, assist the *client* in obtaining relevant information such as referenced in Section 3 of these guidelines;
- make reasonable attempts to obtain from the *client* and others all relevant information related to the *dam safety review*;
- conduct the *dam safety review* in compliance with applicable legislation, these guidelines and using guiding principles in the *CDA Dam Safety Guidelines* and associated technical bulletins;
- notify the *client* as soon as reasonably possible if specialty services or changes in scope of work are required, and of associated changes to the original cost estimate;

- determine whether the *dam* is being safely operated and determine what actions, if any, are required to make the operations reasonably safe;
- write the *dam safety review report* in a reasonably clear, concise and complete manner;
- consider whether conclusions and recommendations in the *dam safety review report* are supported by the appropriate level of analysis, clear rationale and that any assumptions made are clearly stated;
- see that summaries of design calculations are provided in support of the technical analysis in the *dam safety review report*;
- identify in the *dam safety review report* any relevant information/materials regarding the *dam* which are not available and the resulting assumptions made where there is a lack of information;
- provide a statement in the *dam safety review report* that the conclusions and recommendations contained in the *dam safety review report* are only valid for the current operating regime of the *dam* and the current overall environment of the *dam* or the river system, and include a time limit for the statement of the conclusions and recommendations;
- have a draft of the *dam safety review report* undergo *APEGBC's* quality management procedures (see Section 4.0);
- submit to the *client* a signed, sealed and dated copy of the *dam safety review report*, and
- complete a *Dam Safety Review Assurance Statement*.

After the *dam safety review* the *Qualified Professional Engineer* should respond to questions the *client* and/or the *regulatory authority* may have regarding the *dam safety review*, the *dam safety review report*, and/or *Dam Safety Review Assurance Statement*.

The *dam safety review* may be carried out by a team of *APEGBC members* lead by a *Qualified Professional Engineer*. In this situation, the lead *Qualified Professional Engineer* coordinates the work carried out by the other *members*. Many *dams* require a multi-disciplinary systems approach to the *dam safety review* and it is the responsibility of the lead *Qualified Professional Engineer* to see that the *dam* is reviewed as an overall system, that the *members* with the correct qualifications and experience are engaged on the team, that the *dam safety review* is complete and all aspects of *dam* safety are covered. The lead *Qualified Professional Engineer* is also responsible for ensuring the proper coordination occurs between the various *members* of the multi-disciplinary team.

If certain professional activities such as aspects of the field work are delegated by *Qualified Professional Engineers* to subordinates including non-professionals such delegation of professional activities must occur under the *Qualified Professional Engineer's* direct supervision (see Section 4.2 of these guidelines). The *Qualified Professional Engineer* assumes full responsibility for all work delegated in accordance with the *Engineers and Geoscientists Act*.

To fulfill *APEGBC* Code of Ethics Principle 1 (hold paramount the safety, health and welfare of the public, the protection of the environment, and promote health and safety in the workplace), Principle 8 (present clearly to employers and clients the possible consequences if professional decisions or judgments are overruled or disregarded and

Principle 9 (report to *APEGBC* or other appropriate agencies any hazardous, illegal or unethical professional decisions or practices), the *Qualified Professional Engineer* must:

- advise the *client* in writing of the potential consequences of the *client's* actions or inactions, and
- consider whether the situation warrants notifying *APEGBC*, the *dam owner* (if different from the *client*) and/or the *regulatory authority* of the *client's* actions or inactions.

The above actions must be taken if a hazardous condition at the *dam* could possibly result in loss of life and/or other significant negative consequence occurring, or if workplace safety or the environment is potentially jeopardized by the hazardous condition at the *dam*.

2.2.3 The *Engineer of Record*

In BC, ~~-~~all mining dams require an Engineer of Record (EOR)~~EOR~~, whereas conventional water dams may have an EOR, but ~~it is not a requirement~~ there is no requirement to do so.

The following information on the role of the EOR is ~~intended to apply to mining dams only and is~~ consistent with the documentation prepared by the Canadian Dam Association (CDA):

> The Owner is ultimately responsible for the safety and operation of their dam(s) during construction, operation, and closure. Section 2.3 of the *CDA Dam Safety Guidelines* states that the "Owner's policy should clearly demonstrate the organization's commitment to safety management throughout the dam's life cycle". This includes 'delegation of responsibility and authority for all dam safety activities". Further "the owner's staff and any consultants or contractors who carry out dam safety activities on behalf of the Owner should be aware of the decision making process and who is accountable for that". The dam safety Engineer of Record (*EOR*) is an integral part of risk management for mining dams.
>
> The EOR is defined as the professional engineer responsible for assuring that the dam is safe, in that it is designed and constructed in accordance with the current state of practice and applicable regulations, statutes, guidelines, codes, and standards. In the case of an older dam, the EOR would assure that the dam was designed to the applicable standards that were in place at the time of the initial dam design and that the dam is continues to perform at a satisfactory level.
>
> The EOR is an integral part of the risk management system for dams, and provides design continuity and ongoing technical support to the Owner with respect to dam safety issues over the life of the dam. The EOR may also provide input to the operating plans and closure design.
>
> ~~As per the Health, Safety and Reclamation Code for Mines in British Columbia, the EOR reports on annual Dam Safety Inspections, participates in Dam Safety Reviews and risk assessments and provides Quantitative Performance Objectives and monitoring frequencies to ensure the facility as designed for inclusion in the OMS. A tailings The EOR should be engaged during the DSR process and the EOR should review the report.~~

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The EOR is an individual who must be clearly identified by the Owner and must have accepted the responsibility. Whether the EOR is part of the Owner's organization or is contracted externally, they must have the authority and independence to ensure that safety assessments and measures are not compromised by operational ~~concerns~~constraints. Furthermore, in respect to tailings storage facilities, section 10.1.6 of the Health, Safety and Reclamation Code for Mines in British Columbia requires that the EOR notify the manager in writing of any unresolved safety issues that compromise~~s~~ the integrity of a tailings storage facility.

The EOR must have knowledge and experience in the design, construction, performance analysis and operations of dams, to a level that is commensurate with the consequence classification and complexity of the specific dam or dams under their technical authority.

Recommended minimum qualifications include:

- Typically at least 10 years of related engineering experience
- Knowledge of dam design, construction, operations and performance evaluation, gained through solid experience; this broad knowledge is necessary to appreciate the complex issues of dam safety
- Current knowledge of applicable regulations and the state of practice, including CDA Dam Safety Guidelines and other international dam safety guidance
- Registration and good standing with the professional engineering association where the dam is situated

If the EOR is a consultant, then this individual should be supported by a firm that has dam safety specialists who can provide the necessary support and oversight.

The Engineer of Record is separate from the Qualified Professional Engineer who carries out the Dam Safety Reviews. Dam Safety Reviews should ~~muse~~ be carried out by an independent third party not previously involved as EOR for the facility. However the EOR should be engaged during the DSR process and should review all dam safety review reports.

2.2.4 The *Regulatory Authority*

The *regulatory authority* is the department within the Ministries that is tasked with assigning the regulatory requirements of *dam* safety. For freshwater reservoir *dams* this would be the department within the British Columbia government responsible for the status and regulations of the Dam Safety Regulation under the *Water Sustainability Act*. Details of the regulatory requirements for water reservoir *dams* are presented in Appendix A. For mining *dams* this would be the department within the British Columbia's government responsible for the status and regulations of the *Mines Act*. Details of the regulatory requirements for mining *dams* are presented in Appendix ~~C~~B.

In accordance with the *Dam Safety Regulation,* the *regulatory authority*~~-~~ can accept or not accept a *classification proposed by the owner (See Section 3 of the Dam Safety Regulations).* Currently only *dams* with high, very high and extreme *classifications* require legislated *dam safety reviews*. *Dams* with low and significant *classifications* are not required by the *Dam Safety Regulation* to undergo regularly scheduled legislated *dam safety reviews*. However, *dam owners* are required to conduct annual reviews of *dams* with low and significant *classifications* in order to confirm the current *classification* of the *dam*. Additionally, as per Section 21 (4) of the Dam Safety Regulation, a dam

safety officer may request additional information and records that they deem necessary to evaluate the condition or the hazard potential of the dam and operations and actions connected with the dam. If the *classification* changes for any reason such as increased downstream development, then the *regulatory authority* may review and amend the *classification* of the *dam*.

Dams subject to the *Mines Act* require that *dam safety reviews*be carried out at least every five years. ~~for *dams* with significant, high, very high and extreme *classifications* be carried out in accordance with the *CDA Dam Safety Guidelines*.~~

Before the *dam safety review* is initiated, the *regulatory authority* will:

- inform the *client* of the current *classification* of the *dam* if the *client* is not aware of the *classification*;
- inform the *client* by when the *dam safety review* must completed and *dam safety review report* submitted to the *regulatory authority*; and
- provide the *client* with guidelines, if they exist, of the *dam owner's* responsibilities for the safe management of *dams*, as defined in the relevant legislation.

After the *dam safety review*, the *regulatory authority* will:

- review the *dam safety review report* and *Dam Safety Review Assurance Statement*;
- accept the *dam safety review report* or, if the *dam safety review report* does not comply with the requirements of the relevant legislation reject the *dam safety review report*, and
- if necessary, discuss the conclusions and recommendations of the *dam safety review report* and *Dam Safety Review Assurance Statement* with the *client* and *Qualified Professional Engineer*.

2.2.5 External Review of *Dam Safety Review Reports*

A *Qualified Professional Engineer* may be engaged by the *regulatory authority* to carry out an independent external review of a *dam safety review report* prepared by another *Qualified Professional Engineer*. This external review process may be part of the *regulatory authority's* review of the *dam safety review report*. A *client* may also require such an independent external review. These independent external reviews are not the same as an internal or external peer review carried out as a part of the *dam safety review* quality assurance/quality control activities of the *Qualified Professional Engineer* prior to submitting the *dam safety review report* to the *client* (refer to Sections 4.3 and 4.4).

In order for the reviewing *Qualified Professional Engineer* to carry out an appropriate independent external review, it is helpful if the requesting *regulatory authority* or *client*:

- allows the intent of *APEGBC* Code of Ethics Principle 7 to be followed; specifically, item (c), which states that a *member* should not, except in cases where review is usual and anticipated, evaluate the work of a fellow *member* without the knowledge of, and after communication with, that *member* where practicable;
- provides the reviewing *Qualified Professional Engineer* with a copy of the *dam safety review report* and *Dam Safety Review Assurance Statement*, necessary background information, and the reason for the review; and

- discusses the *dam safety review report* with the reviewing *Qualified Professional Engineer*.

The reviewing *Qualified Professional Engineer* should consider whether there may be a conflict of interest and act accordingly (*APEGBC* Code of Ethics Principle 4), and conduct himself/herself with fairness, courtesy and good faith towards colleagues and provide honest and fair comment *(APEGBC* Code of Ethics Principle 7).

Following guideline (c) of *APEGBC* Code of Ethics Principle 7, the reviewing *Qualified Professional Engineer* must:

- if authorized to do so, inform the *Qualified Professional Engineer* who prepared the *dam safety review report* and *Dam Safety Review Assurance Statement* of the review, the reasons for the independent external review and document that communication;
- ask the original *Qualified Professional Engineer* if the reviewing *Qualified Professional Engineer* should know about any unreported circumstances that may have limited or qualified the *dam safety review*, the *Dam Safety Review Assurance Statement* and/or the *dam safety review report*; and
- with the *client's* authorization, contact the original *Qualified Professional Engineer* if the results of the independent external review have identified safety or environmental concerns, and allow the original *Qualified Professional Engineer* to comment on the results of the independent external review prior to further action.

The reviewing *Qualified Professional Engineer's* review should be appropriately documented in a letter or a report. The reviewing *Qualified Professional Engineer's* signed, sealed and dated independent external review letter or report should include:

- limitations and qualifications with regards to the review, and
- results and/or recommendations arising from the review.

The reviewing *Qualified Professional Engineer* should respond to any questions the *regulatory authority* or *client* may have with regard~~s~~ to the review letter or report.

Occasionally, a *Qualified Professional Engineer* is retained to provide a second opinion. This role goes beyond that of an independent external review of the original *Qualified Professional Engineer*. The second opinion *Qualified Professional Engineer* must carry out sufficient pre-field work, field work, analysis and comparisons, as required, to accept full responsibility for his/her *dam safety review*.

3.0 GUIDELINES FOR PROFESSIONAL PRACTICE

3.1 GENERAL PRINCIPLES

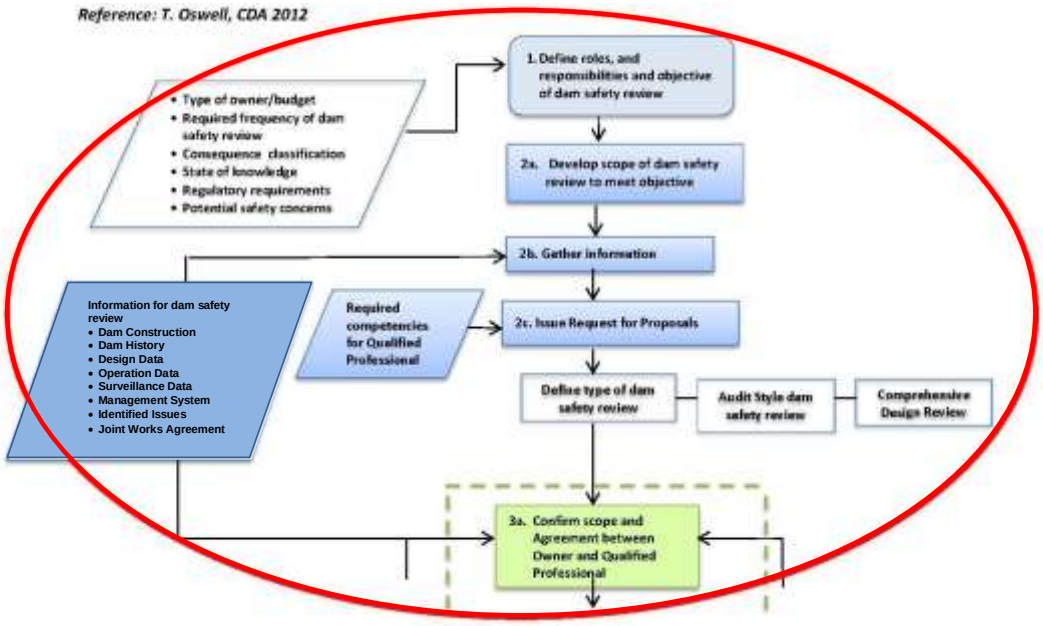
A *dam safety review* involves a systematic review and evaluation of all aspects of the design, construction, maintenance, operation, processes and systems affecting a *dam's* safety, including the *dam* safety management system. A *dam* is part of the altered natural environment and as such the natural environment will impose hazards on the *dam* that are beyond the control of the *dam owner* or *dam* operator. The hazards and risks are difficult to define and quantify and the understanding of these hazards and risks often change over time. The knowledge and interpretation of these natural hazards at the time of the original design and construction and the engineering standards, methods and procedures used for the original design and construction may be significantly different than the current engineering standards, methods and procedures of today. The evaluation of the safety of the *dam* system for the *dam safety review* must use the current knowledge and standards for *dam* engineering.

The level of service required for a *dam safety review* must be commensurate with the complexity of the *dam* system and the *dam classification*. In addition, the level of service required may be dictated by the availability, or lack thereof, of documentation and data to determine whether or not the *dam* meets current engineering design principles. Regardless of the level of complexity required for the *dam safety review*, the *Qualified Professional Engineer* must carry out the *dam safety review* in sufficient detail so that the conclusions reached and recommendations arising out of the *dam safety review* can be made with the same level of confidence.

3.2 *DAM SAFETY REVIEW* PHASES

Each *dam safety review* will consist of a number of steps or phases that together will form the framework of the review. These steps generally need to be carried out in a systematic order to achieve the desired results in a reasonably effective manner. A *dam safety review* will include a field review of the site, review of all relevant documentation, interviews with site staff, review of incident, maintenance, inspection and other pertinent records, testing of flow discharge equipment (where applicable) or review of recent test records. The *dam safety review* process is based on the appropriate regulations or guidelines adapted by the *regulatory authority.* The *dam safety review* is the *owner's* responsibility and will typically start with the relevant statute requirement and include the following initial items as depicted in Figure 2.

Figure 2: Steps in Initiating a *Dam Safety Review*



In general, the following phases or steps should be carried out to complete a *dam safety review*. The following information is intended to assist with defining the scope and requirements of the *dam safety review*. However, it is not exhaustive, and professional judgment is required when adding or subtracting specific steps.

Phase 1 (Review of available information and data):

- It is strongly recommended that a written *agreement* between the *client* and the *Qualified Professional Engineer* be put in place before any work is initiated. This *agreement* should address, scope of work, objectives, expectations, responsibilities, level of service, schedule and anticipated extent of the study area, as noted in Section 2 of these guidelines;
- The *Qualified Professional Engineer* must request from the *client* all available documentation and data for compilation and review, such that all relevant background information on the *dam*, the river system (if relevant) and the *dam* management system is considered (Section 3.3). If there is uncertainty whether any documentation is relevant, it is the *Qualified Professional Engineer* who must make that determination;
- The *Qualified Professional Engineer* must understand the current *dam classification* as determined by the *regulatory authority* and identify performance expectations based on current guidelines, regulations, generally accepted practices, and consideration of changed conditions (Section 3.6);

- The *Qualified Professional Engineer* must provide an initial facility overview (spatial and functional model of the *dam*/reservoir system) as it relates to the safety of the *dam* and other barriers (water or otherwise) in the system (principal functions of components) as shown in Figure 2. This should be reviewed and updated in Phase 3 after a site inspection and further analysis; and
- The *Qualified Professional Engineer* must review and assess the *dam* safety management obligations and procedures including emergency planning, operations and maintenance, surveillance, staff training, documentation, and deficiency tracking and resolution (Section 3.3).

Phase 2 (Field Review):

- The *Qualified Professional Engineer* must carry out field review(s) of the *dam*, the reservoir (or impoundment), and the catchment areas both upstream and downstream of the reservoir or impoundment to understand the current condition of the *dam* and appurtenances, the flow control equipment at the *dam*, water management and flood control structures, the reservoir or impoundment environment, upstream hydrological impacts (logging roads and bridges for example) and the development downstream of the *dam*;
- Preferably during the site visit, the *Qualified Professional Engineer* will interview (when relevant) the operating personnel who conduct routine inspections, surveillance of the *dam* and maintenance of operating systems (e.g. flow control equipment). The *Qualified Professional Engineer* will review available maintenance records and audit all the documentation that should be on site, such as the Operations, Maintenance and Surveillance (OMS) Manual and the Dam Emergency Plans; and
- If flow control equipment is present, the *Qualified Professional Engineer* will witness testing of the flow control equipment or if the flow control equipment is routinely and regularly used, should satisfy himself/herself that the equipment is in good working order by reviewing the operating and maintenance records.

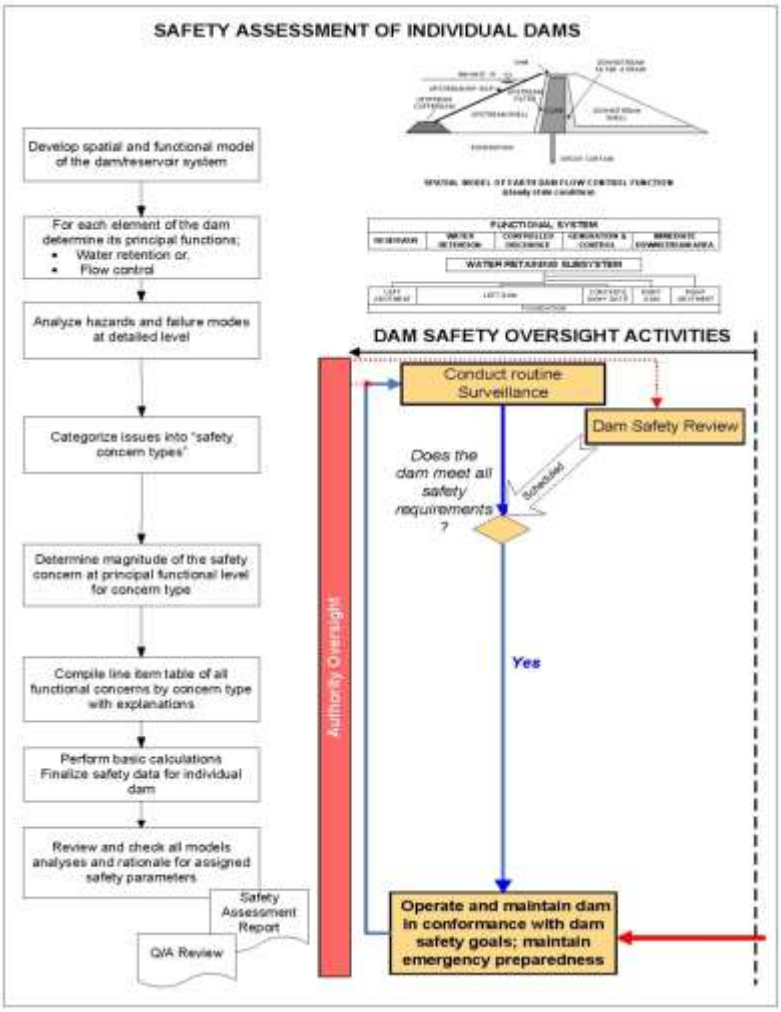
Phase 3 (Evaluation):

- Following the field review(s), the *Qualified Professional Engineer* must confirm that the *dam classification* is appropriate or if it should be reviewed and amended. The *Qualified Professional Engineer* should state whether there has been any changes since the last *dam safety review* that would warrant change of the *classification* and, provide an explanation in the *dam safety review report*. If the *dam classification* should be reviewed and amended, the *client* and *regulatory authority* are responsible for confirming that the change in the *dam classification* is to be carried out. Identification of the required *dam* safety criteria in relation to the appropriate *classification* (includes considerations of changed conditions, Section 3.6) should be in place prior to the *dam safety analysis*;
- The *Qualified Professional Engineer* must then carry out the *dam safety analysis* for the *dam* using either the current *classification* if it is appropriate, or any new *classification* and determine whether or not the *dam* meets the *dam* safety criteria and whether the *dam* is being operated in a reasonably safe manner. Evaluation of the *dam* performance should be carried out in relation to the facility condition,

applicable internal and external hazards and applicable failure modes and may follow the steps of a safety assessment depicted in Figure 3 below;

- The *Qualified Professional Engineer* must then identify and characterize deficiencies in the safe operation of the *dam* and non-conformance in the *dam* safety management system and recommend the actions that should be taken to either investigate the deficiencies in more detail or the actions that must be taken to rectify the deficiencies and non-conformance; the *Qualified Professional Engineer* must also determine the severity of the *dam* safety concerns;
- The *dam safety review report* and the *Dam Safety Review Assurance Statement* must then be prepared by the *Qualified Professional Engineer* and after passing the internal quality assurance/quality control process, be submitted to the *client*; and
- Once the *client* has reviewed the *dam safety review report*, the *Qualified Professional Engineer should* discuss the conclusions and recommendations with the *client* and provide any clarifications requested by the *client*.

Figure 3: Draft Example *Dam Safety Review* Process (this particular example is for water reservoir *dams* but the same fundamental steps apply for mining *dams*)



3.3 BACKGROUND INFORMATION

A *dam safety review* requires an understanding of the site conditions, construction methodology and practices used for the construction and ongoing monitoring of the *dam*. A complete set of design and service records provides a reliable basis for evaluations and decisions regarding possible unacceptable performance and potential *dam* safety improvements. This information will facilitate the *dam safety review* and must be reviewed as part of the *dam safety review*; if unavailable, follow-up action may be required and is to be noted in the *dam safety review report*. Some of this information is listed below, a more complete listing is provided in Appendix E and for mining *dams* in Appendix C. The relevant documents include:

- *Owner* and organizational information such as the *owner's dam* safety management system, organizational charts and responsibilities; applicable regulations (water license, permits, orders), and operational obligations (laws, regulations obligations and stakeholder *agreements*).
- Design and construction records including design documentation, as-built drawings, first reservoir/containment filling data, and original *classification*.
- Annual, routine or special *dam* safety inspection documents together with the *dam* performance and safety history.
- Operation of discharge facilities including operating parameters and procedures, inflow forecasting, summary of critical, maximum and other important levels of stored volume or stored materials, emergency or unusual operations and other items typically included in the OMS Manual.

Particularly with respect to older *dams*, the *Qualified Professional Engineer* needs to be cognizant of potential changes of safety criteria particularly with respect to floods, earthquakes and downstream consequences. Potential updates to the original design criteria may be necessary if the *classification* has changed. Additional considerations, changed conditions or increased knowledge may include alteration to discharge capacity (due to conversions of gates, settlement of embankment, or obstructions such as debris or ice, undetected foundation/abutment problems, or construction defects).

The *Qualified Professional Engineer* must consider the reliability of the background information which is reviewed as part of the *dam safety review*. If information is known to be available and the *Qualified Professional Engineer* did not (or was not able to) obtain it, the circumstances, including any information gaps, must be discussed with the *client* and reported in the *dam safety review report*.

This section, Appendix D~~E~~ and Appendix B~~C~~ for mining *dams,* are intended to provide a general outline of the type of background information that must be considered while recognizing that the specifics around background information, including what is relevant, will vary depending upon the nature of the *dam* undergoing a *dam safety review*. Professional judgment must be used for the analysis and correct interpretation of both primary and indirect sources of information and data. The *dam safety review report* will state the origin of the data used in the analysis and the assumptions made by the *Qualified Professional Engineer*.

3.4 FIELD WORK

All *dam safety reviews* must include a comprehensive field review, testing of discharge facilities (when relevant), checking site communications and staff/*owner* interviews. The field work will generally follow a review of available information and is an important first step in the (Phase 2) field review and evaluation process; the *dam safety review* will rely to a large extent on the information obtained during the field work. This *dam safety review* requirement is described in the *CDA Dam Safety Guidelines*.

The extent of the area reviewed will include both upstream reservoir rim areas and downstream areas. Downstream areas may be impacted by inundation by direct flooding or through the triggering of other hazards such as failure of downstream facilities or downstream landslide or debris flow. The Testalinden failure near Oliver BC in July 2010 provides a recent example of this hazard and is discussed in more detail in Appendix ~~I~~H.

Further information regarding important aspects of the field work including *dam* reviews, testing of discharge facilities (if present), and other information relevant to the field work is summarized below and described in Appendix F in more detail. This information outlines some important issues and areas to be reviewed, though it will be the *Qualified Professional Engineer's* responsibility to identify the pertinent areas to be reviewed and apply the appropriate techniques:

- Visual review(s) - Should focus on functional integrity, hazards, failure modes and failure mechanisms to provide a qualitative observation-based analysis of the condition of the *dam* and its surroundings. Testing of discharge facilities (spillways, diversions, decants and low level outlets) including all necessary equipment required for safe discharge of floods must be in place and well maintained such that they operate reliably. This should include the capability and availability of the operators assigned to the *dam* to be able to operate, in a timely manner, discharge facilities.
- Debris loading - Episodic debris loading can be critical for many *dams* and reservoirs in British Columbia as debris blockage can significantly reduce the discharge capacity of the outlet facilities. The containment of reservoir debris must be managed so that the safety of the *dam* is not impacted.
- Instrumentation - Review of the *dam* monitoring system (if present) should be carried out to ascertain its effectiveness in determining the behavior of a *dam* and its foundation relative to the applied loading conditions and to detect any signs of abnormality.
- Communications - Transmission of data and communication to and from the *dam* site is also important to the safety of the *dam* and worker safety. Vital communications should be tested as part of the *dam safety review* field work.
- Staff Interviews – This is described in the *CDA Dam Safety Guidelines*.

3.5. *DAM SAFETY ANALYSIS* (HAZARDS, FAILURE MODES, AND CONSEQUENCES ANALYSES)

3.5.1 General

In general terms, the endeavor of *dam* safety management has to recognize and accommodate the fact that ageing and normal wear and tear present constant challenges, and that new threats to the safety of the *dam* sometimes emerge. In this

context, the purposes of a *dam safety review* are to assess if there has been any significant deterioration in the level of safety, which can be estimated in terms of an increased risk position, since the last *dam safety review*, and to determine if the overall level of risk is being maintained within limits considered to be tolerable. To exclude risk altogether is impossible, for *dams* or for any significant hazard.

The *dam safety review* is intended to provide a snapshot of the condition of the *dam* and the risks that it presents as part of a process of review within the requirements of the *regulatory authority*; and, to identify and measure, so far as possible, new risks, such that necessary improvements in the risk position can be identified. The *dam owner* can then use the results of the *dam safety review* to initiate development of any needed designs and repairs, as soon as it is practicable.

3.5.2 Context and Hierarchy of Principles for *Dam Safety Reviews*

The determination of what is the acceptable level of risk or safety for the various elements which are identified as being at risk is not the role of the *Qualified Professional Engineer* and is outside the scope of the *dam safety analysis*. The acceptable level of risk must be established and adopted by the *regulatory authority* in consultation with the *dam owner*. However, an assessment of the various elements at risk, through the *dam* failure consequences *classification* established by the relevant *regulatory authority* will guide the *Qualified Professional Engineer's dam safety analysis*.

The process for analyzing *dam* safety requires creativity, where people identify the variety of routes by which an existing *dam* could reasonably endanger people, property and the environment. A range of options to address these threats to the performance and functional integrity of the *dam* can then be identified, from which reasonable alternatives can be identified to protect the safety of the *dam*. However, the extent to which this process can be applied may also depend on numerous factors that are outside the scope of the *dam safety analysis* process. *Dam safety analysis* is carried out within the context of a *dam safety review*. However, it cannot be completed without consideration of contextual factors such as these identified in Appendix ~~G~~F (societal, *owner* and affected individuals). Against this background is a "Hierarchy of Principles" as outlined in Appendix ~~G~~F.

This Hierarchy of Principles provides a model for cascading downwards from the broadly based principles of a democratic society through the various constitutive societal arrangements that govern the purposes and the professional practice of *dam safety reviews* and *dam safety analysis*.

This Hierarchy of Principles leads to a comparable hierarchy of purposes and expectations of *dam safety reviews*, which in turn leads to a hierarchy of types of *dam safety reviews*. The end result of this principles-based approach is the capacity to provide *dam safety reviews* with degrees of resolution in proportion to, and appropriate for, the intended purposes of the *dam safety reviews*.

The following principles based approach has been developed for performing *dam safety analysis*. These principles are presented below. The overarching principle, regardless of the degree of resolution in the analysis, being that the *Qualified Professional Engineer* should perform the *dam safety analysis* in a manner that reveals the variety of routes by which a *dam* can endanger people, property and the environment enabling the *Qualified Professional Engineer* to identify the range of options to control these threats to the

performance and functional integrity of the *dam*. This would enable the *Qualified Professional Engineer* to perform the safety assessment and to make the determination of the safety status of the *dam*.

The principles based approach to *dam safety analysis* requires:

(i) an extensive understanding of the *dam* and associated systems both in the present and the foreseeable future, its behaviour in a variety of conditions, experience of failures of other *dams* and the measures adopted to prevent their recurrence;

(ii) an understanding of how people and organizations affect the safety of the *dam*;

(iii) imagination to identify potential failure modes that could arise at the *dam* or with the people involved in managing safety, and opportunities for prevention, control and mitigation.

The *dam safety review* should state the extent of the understanding gained during the course of the *dam safety review* and the degree to which the scope of the *dam safety review* permitted the analysis of failure modes and the identification of safety measures.

3.5.3 Implementation Principles

The implementation of this principles based approach as provided above comes from the principles for *dam* safety management that are commonly adopted in *dam* safety assessment in Canada, as described in the *CDA Dam Safety Guidelines*. The International Commission on Large Dams provides a complementary set of principles that serve as a basis for the managerial aspects of the *dam safety review*. The *dam safety review* can be carried out in terms of these principles, or some other suitable set of principles. If another set of suitable principles are to be followed, they must be clearly referenced and the basis of their suitability documented.

Dams are designed to perform certain functions, and *dam safety analysis* involves two fundamentally different dimensions of the safe performance of a *dam*:

- the physical capacity of the *dam* to withstand applied loads associated with the hazards of the environment at the *dam's* location (limit of the design envelope); and
- the functional capacity of the *dam* to safely perform its functions (containment and conveyance).

The engineering principles involved in *dam safety analysis*, and in setting the engineering dimensions of the framework for a *dam safety review*, can be set in terms of the management concept of "Loss Avoidance". In the context of *dams*, avoidance of loss typically could range from loss of the *dam* and its contents to loss of control of the functions of the *dam* which can be broadly defined in terms of the concepts of containment (of the stored volume and/or stored material (mining *dams*)) and conveyance (of the flows through and around the *dam* in a controlled way).

The *dam safety analysis* process involves consideration of the various relevant engineered and operational safety control measures:

- prevention of loss of performance capacity or loss of functional capability;

- control of the deviations from designed performance characteristics; and
- mitigation of the effects of loss of control of the containment and conveyance functions.

Since *dam* safety management involves implementing preventative, control and mitigation measures to various degrees to ensure the functional safety of the *dam*, the *dam safety analysis* should reveal the balance across and between these measures and the extent to which functional performance is assured.

There are a number of engineering principles that the *Qualified Professional Engineer* may use to guide the *dam safety analysis* as follows:

1. Redundancy: More than one way to achieve the desired performance;
2. Diversity: Different ways to achieve the same function for a *dam* system;
3. Segregation: Function served from different locations and directions;
4. Defense in depth: Large margins of capacity over demand (in all systems – including redundant systems);
5. Fault tolerance (include human fault tolerance): A single fault will not cause loss of *dam* system function; and
6. Fail to a safe condition: If a part of the *dam* system does fail, it will render the *dam* to a safe condition.

The *dam safety analysis* is intended to reveal the extent to which the above engineering principles, or other suitable principles, have been put in place at a *dam*.

Below is a summary of the important concepts to be followed in implementing this principles based approach for carrying out *dam safety reviews*:

- The *dam safety review* should be framed in the context of generally accepted *dam* safety management principles. The principles that are selected should be documented and their application in the *dam* safety assessment should be explained.
- The *dam safety review* must identify the performance capacity dimensions and the functional capability dimensions of the *dam safety analysis*.
- The *dam safety review* must identify the degree to which preventive, control and mitigation measures are in place at a *dam*, and the analysis should determine the adequacy of these measures both individually and collectively as a “safety system”.
- The *dam safety analysis* should identify the degree to which the six established engineering principles described above have been implemented.

3.5.4 Elements of *Dam Safety Analysis*: Hazards, Failure Modes, Failure Effects and Consequences

Dam safety analysis involves the analysis of hazards, failure modes, failure effects and the consequences of functional failures. This includes combinations of hazards and failure modes as well as analysis of the relationship between hazards and failure modes.

The following is a summary of the most important concepts to be considered when carrying out a *dam safety analysis*:

- Identify all relevant external and internal hazards or threats, and their combinations that have the potential to interfere with the safe functioning of a *dam*; the degree of seriousness of each hazard or combination of hazards, and whether or not the hazard condition can be characterized in probabilistic terms.
- Identify how the hazards may act on a *dam*, the manner in which a *dam* responds to the influence of the hazards, and the consequences of functional failure of the *dam* due to the hazards.
- Identify all relevant functional failure modes and the *dam safety analysis* must characterize the manner in which the *dam* responds to the influence of relevant hazards. The *dam safety analysis* should also demonstrate how these failure modes can be transformed into physical failure mechanisms.
- Consider the functionality of the *dam* as a containment and conveyance system after significant natural events.
- Consider the possible impacts of other interdependencies between conditions such as management, procedural and operational factors on the functionality of the *dam* after significant natural events.
- Report the results of the analysis of the relationships between the hazards and failure modes, as well as any interdependencies between hazards and failure modes in the *dam safety review report*.
- The consequences analysis component of the *dam safety analysis* should be the basis for establishing the *classification* of a *dam* based on the extent of the inundation arising from the failure of one or both of the containment or conveyance functions.
- The consequences analysis should be structured to provide data on loss of life; environment and cultural values; and, infrastructure and economics in accordance with the requirements of the *regulatory authority*.
- The consequences analysis should state the manner in which the downstream region was modeled and identify the entities and objects considered in the model.
- The consequences analysis should state the degree of resolution of the analysis.
- The consequences analysis should state the manner in which the impacts of the flows from the *dam* were determined including any dynamic space and time considerations.

Further detail on the considerations which need to be addressed when carrying out a *dam safety analysis* so the intent of the above referenced concepts are met, is provided in Appendix ~~H~~G.

3.5.4.1 External Hazards of Particular Importance in British Columbia

The natural environment and climate of British Columbia, and its associated natural hazards require that the *dam safety review* pays particular attention to possible meteorological; geological; environmental; and seismological events. These are generally considered in terms of floods, landslides and seismic events, although such

simple categorization masks the complexity of these hazards, which can act in combination.

The *dam safety review* should take appropriate account of the nature and complexity of these hazards and should explain how they have been addressed in the *dam safety review*.

Refer to Appendix ~~I~~H for information on how loadings from natural hazards can be included in a *dam safety review* both individually or in combination.

3.5.5 Methods of *Dam Safety Review*

Since there is no standardized and generally accepted method of *dam safety review*, the *Qualified Professional Engineer* should recommend a suitable level of service based on several factors including but not restricted to:

- current *classification* of the *dam*
- age of the *dam*
- use of the *dam*
- type of design and method of construction of the *dam*
- previous *dam* safety management history
- previous *dam safety reviews*
- recent and on-going performance observations and analyses of the *dam*

The types of *dam safety review* can be broadly considered to cover a spectrum ranging from an audit-type review to a comprehensive and detailed design and performance review. The *Qualified Professional Engineer* should recommend an approach to the *dam safety review* that will cause the result of the *dam safety review* to be appropriate for its intended purpose. Secondary considerations will involve factors such as being appropriate for the *dam* safety management needs and the existing *dam* safety management arrangements. It may be necessary for the *Qualified Professional Engineer* to recommend a phased approach to the *dam safety review*. This would be appropriate in instances where the actual end use of the *dam safety review* is to inform a debate in the public domain concerning a matter of significant societal importance, but where the existing *dam* safety management arrangements may be insufficient to support a *dam safety review* that would be suitable to inform a public debate.

In many cases an iterative approach may be appropriate beginning with an audit-type review with recommendations for subsequent reviews of increasing detail and rigour as considered necessary to meet the end-use objective which includes the relevant regulatory requirements.

The following is a summary of the most important concepts for implementing an appropriate methodology when carrying out a *dam safety review*:

- All aspects of the *dam safety review* should conform to the current *APEGBC* guidelines on quality management of engineering services.
- Typically, a *dam safety review* shall be carried out by one or more *Qualified Professional Engineer(s)*. Where a team is involved the lead *Qualified Professional Engineer* will be the responsible *Qualified Professional Engineer*. The *Qualified Professional Engineer* responsible for an audit type review is expected to be sufficiently knowledgeable and experienced to act as the responsible *Qualified Professional Engineer* for all aspects of a *dam safety review*.
- The methodology is consistent with the expectations of the *regulatory authority*.
- The method used for a *dam safety review* should suit its intended purpose, and be in accordance with the results based contextual factors and principle based approach described in Section 3.5.2.
- In all cases, and to the extent that is appropriate in terms of established methods of safety assessment, the *dam safety review* should disclose the evidence developed in the *dam safety review* and the line of reasoning that connects that evidence to the determination of the safety status of the *dam*.

3.5.5.1 Audit-Type *Dam Safety Review*

The audit-type *dam safety review* is intended to review the currency and adequacy of all of the safety management arrangements in place for a *dam* on the basis of a review of documentation, site reviews, interviews with operating staff and preliminary engineering analysis. The currency dimension of the review focuses on the suitability of all information, systems, and safety controls used and *dam* safety management in the context of established *dam* engineering practices. The adequacy dimension of the review focuses on the extent to which the safety management arrangements that are in place meet or exceed industry norms, and the expectations of the *regulatory authority*.

By definition, there will be a limit to how often an audit-type *dam safety review* can be carried out for an individual *dam* unless there has been a continual process of updating of information and upgrading of the *dam.* However, changes over time will render the audit-type basis for the review no-longer current or adequate.

Adoption of an audit-type *dam safety review* may be appropriate as an interim measure or as a precursor to more detailed forms of *dam safety review* at the next scheduled formal review.

3.5.5.2 Comprehensive *Dam Safety Review*

A comprehensive *dam safety review* comprises all of the elements of an audit-type of *dam safety review*, but with each element carried out in a more in-depth way by a *Qualified Professional Engineer* under the direction of the lead *Qualified Professional Engineer*. In this regard, the review of documentation, site reviews, and interviews with operating staff will be more detailed, and may include a second verification site visit at the *dam safety review report* preparation stage. The engineering analysis will involve a routine design-basis check of calculations with subsequent site verification. It is the regulatory authority's expectation that the default type that must be carried out by a dam owner under the provision of the Regulation is a comprehensive review. An audit style

review will not be accepted unless prior written approval has been provided by the Regulatory Authority.

3.5.5.3 Detailed Design-Based Multi-Disciplinary *Dam Safety Review*

A detailed design-based multi-disciplinary *dam safety review* is carried out by a team of *Qualified Professional Engineers* under the guidance and direction of the lead *Qualified Professional Engineer* who is responsible for the integrity of the review as a whole. A detailed design-based multi-disciplinary *dam safety review* is equivalent to a full scale independent design review of an engineered system. The review of documentation, site reviews, and interviews with operating staff may require several site visits or even a period of residence at the site for the purpose of verifying the integrity of the input data to the analysis.

3.5.5.4 Comprehensive and Detailed Design and Performance Review

A comprehensive and detailed design and performance *dam safety review* includes a detailed performance analysis of the *dam* over its operating life but also considers the attributes of a detailed design-based multi-disciplinary *dam safety review*. A *dam safety review* of this scale and rigour can be expected to take a considerable period of time and be highly resource intensive. In many cases, essential design and performance information may be lacking thereby necessitating exploratory investigations and detailed sub-studies to assemble sufficient evidence and knowledge on which to base the *dam safety review*.

3.5.6 Consideration of Safety and Risk

The purpose of the *dam safety review* is to:

- determine whether the *dam* is safe, and
- if it is determined that the *dam* is not safe, to determine what actions are required to make the *dam* safe.

Additional considerations for environmental safety of mining *dams* are presented in Appendix C.

Since, safety is a relative concept, and since the safety of a *dam* changes over time in response to changing conditions internal and external to the *dam*, the *dam safety review* can do no more than provide a “snapshot in time” of the safety status of the *dam* in relative terms.

The safety status of a *dam* can be determined relative to, and in terms of:

(i) Established *dam* designs and generally accepted *dam* safety management measures that are used in the industry.

(ii) Conformance to established engineering principles for the design, construction, maintenance and operation of *dams* that represent a similar degree of risk.

(iii) If necessary, formal consideration of the tolerability of the risks associated with the *dam* may be required in the unlikely event that adequate safety cannot be demonstrated in terms of established practices and precedents, and engineering principles. In such an event, the *dam safety review* should demonstrate the extent to which practices and precedents, and engineering principles can be applied.

In all cases, the determination as to what constitutes “acceptably safe” is not part of the *dam safety review* process. Rather, with respect to safety determinations based on practices and precedents and engineering principles, the onus is on the *Qualified Professional Engineer* to understand whether the *dam* conforms to appropriate design, operation and maintenance norms for a *dam*. In such cases, the actual determination of the safety status of a *dam* relative to these norms will be a matter of reasoned judgment by the *Qualified Professional Engineer*.

In those cases where there is consideration of what is an acceptable level of safety to those elements at risk downstream, in the determination of the safety status of the *dam*, the onus is on the *Dam Owner* in consultation with the *regulatory authority* to determine what constitutes an unacceptable degree of risk. Such a determination by the *dam owner* and the *regulatory authority* would include considerations regarding people, property and the environment downstream of a *dam*, and the extent to which any risk-informed safety determination should err on the side of safety. Any such determinations should be included in the *dam safety review*.

3.5.6.1 Consideration of Functional Integrity of a *Dam* as Part of a System

The various components of a *dam* are to be considered in their entirety as an overall *dam* system. How the various components of a *dam* system interact must be taken into consideration as part of a *dam safety review*. Please refer to Appendix G~~H~~ for further discussion on this matter.

3.5.6.2 Consideration of Uncertainty

It is acknowledged that there is a certain level of uncertainty associated with many aspects of *dam* safety assessments. Please refer to Appendix ~~H~~G for further discussion on this matter.

3.5.6.3 Role of *Dam Safety Analysis* and Risk in the *Dam Safety Review Assurance Statement*

The *Dam Safety Review Assurance Statement* introduces the term “reasonably safe” which, in terms of these guidelines is intended to mean that the *dam owner* has implemented all *dam* safety management measures which conform to those norms that are considered by the *regulatory authority* and the *Qualified Professional Engineer* to reasonably reflect established engineering and *dam* safety management practices.

In this regard, it is expected that the *dam owner* would implement reasonably practicable measures to assure the safety of the *dam* based on the engineering principles set out in these guidelines. Conformance to the engineering principles described in these guidelines together with conformance to the principles of the *CDA Dam Safety Guidelines*, generally recognized international practices, and compliance with expectations of the *regulatory authority* would normally constitute an effective demonstration of the reasonableness of the safety management measures provided in the *Dam Safety Review Assurance Statement*.

Alternative arrangements of safety management measures to achieve a reasonably safe condition are available to the *dam owner* should conformance to the engineering principles, accepted norms and regulatory expectations prove to be impracticable either in the short term or in the long term. Under such circumstances, developing a suite of

safety management measures to identify that a reasonably safe condition has been achieved can be established by demonstrating conformance to the following:

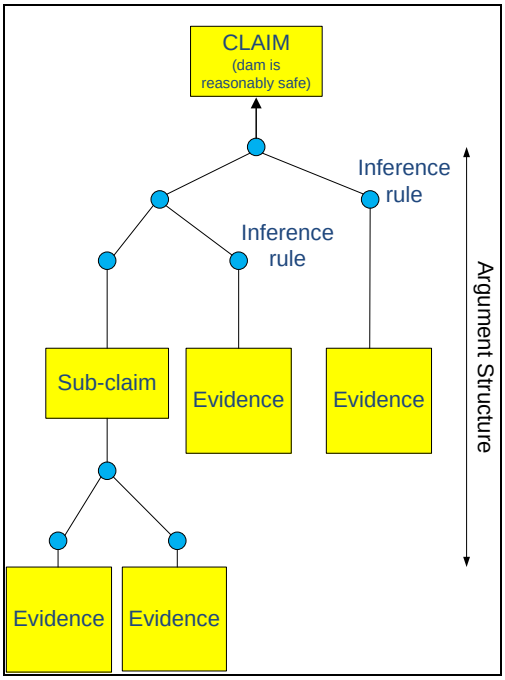
- the engineering principles described in these guidelines (see Section 3.5.3);
- the principles of the *CDA Dam Safety Guidelines*;
- generally recognized international practices;
- the expectations of the *regulatory authority*; and/or
- a set of *dam* specific enhanced safety management monitoring, surveillance and emergency intervention plans agreed to by the *regulatory authority*.

The achievement of a reasonably safe condition can also be demonstrated in terms of a detailed quantitative risk assessment that has been independently reviewed by recognized experts acceptable to the *regulatory authority*.

In all of the above, it is not intended that the *Qualified Professional Engineer* would be required to carry out the demonstration that a reasonably safe condition has been established. Rather, it is the responsibility of the *Qualified Professional Engineer* to verify that such a safety demonstration has been established by the *owne*r.

In discharging their professional responsibilities with respect to these guidelines, the *Qualified Professional Engineer* would be expected to provide a clear explanation as to why the assurance that the *dam* is reasonably safe can be accepted by the *dam owner* and the *regulatory authority*. Such a demonstration would link the conclusion that the *dam* is reasonably safe to the supporting evidence by means of lines of reasoning and inference rules that connect the evidence to the conclusion (Figure 4).

Figure 4: Conclusions-Argument-Evidence Structure to support *Dam Safety Review Assurance Statement*



A conclusion that a *dam* is not reasonably safe would be explained in a similar way whereby the evidence could be shown to be inadequate in terms of accepted norms and where logical inferences cannot be made to properly connect the evidence to the conclusion.

3.5.6.4 Risk-Informed *Dam*-Safety Decisions and Improvements

One purpose of the *dam safety review* is to enable the *dam owner* to use the results of the *dam safety review* to initiate development of designs and repairs to restore the level of safety of the *dam* as soon as it is practicable.

The following outlines the risk-informed approach to selecting the most appropriate of the available options for improving the safety of a *dam*. The result of the *dam safety review* combined with the result of the *dam* safety improvements should then provide key input to the next *dam safety review*.

In some cases, the minimum level of safety of a *dam* can be achieved by means of different configuration of containment and conveyance, and different degrees of reliance on preventative, control and mitigation safety measures. The *dam safety review* should consider the different configuration of safety arrangements that could be in place at a *dam*.

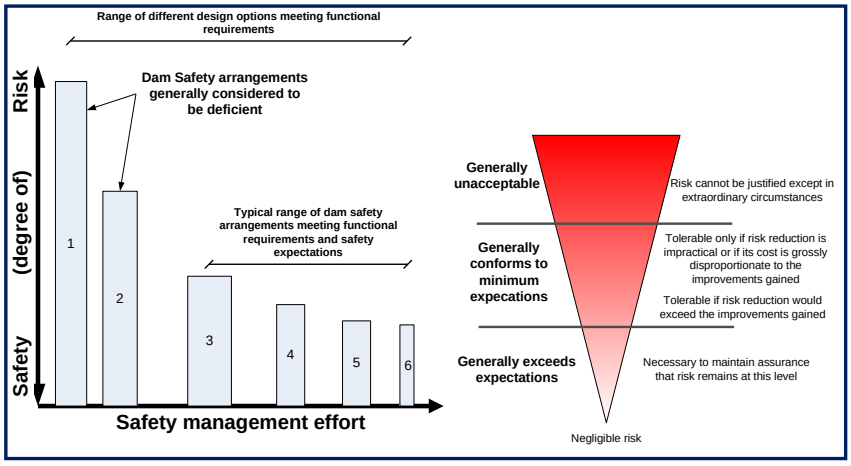
The results of the safety assessment may be represented in various ways as illustrated in International Commission on Large Dams Bulletin 154 and in the concepts of risk-informed identification of safety engineering solutions. One method of illustrating the various extents to which the fundamental principles of protection, control and mitigation are represented in the safety arrangements for a *dam* is by means of the graphical “bow-tie” safety management model (International Commission on Large Dams Bulletin 154).

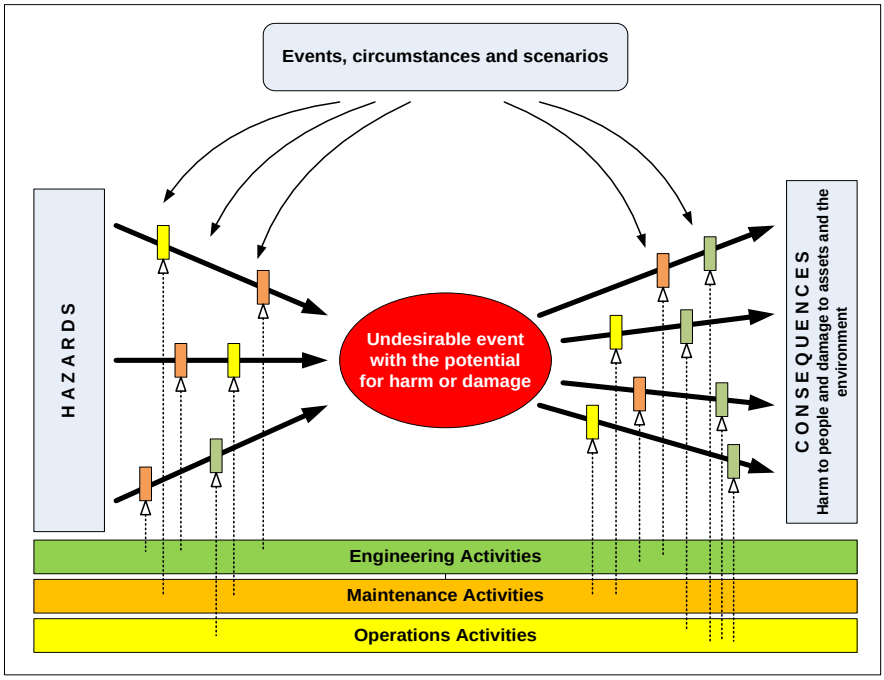
These “bow-tie” models of safety analysis and safety management clearly illustrate the relationship between accepted practices, safety assessment and safety management methods. In particular, the three categories of activities listed above can be found as barriers in this analysis.

Typically, the safety status of the *dam* that has been the subject of the *dam safety review*, the “as-is condition”, can be represented in terms of the left most option (option 1) of the options illustrated in Figure 5 below (upper diagram). Available options for improvement of safety, some of which may be identified in the *dam safety review*, can subsequently be developed and the costs and benefits of the improvements illustrated along-side the safety status of the *dam* as determined in the *dam safety review*.

The nature, form and type (preventive, control, mitigative) of the safety improvements that are selected for implementation can be illustrated in the “bow-tie” model Figure 5 (lower diagram).

Figure 5: Risk-informed *Dam* Safety Improvements (B154, ICOLD, 2011)





3.6 CONSIDERATIONS OF CHANGED CONDITIONS

The *dam safety review* is a snapshot at a particular point in time of the assessment of whether the *dam* is being reasonably safely operated using the current state of practice for *dam safety analysis*. *Dams* are physically located in an ever changing environment and downstream developments may impact the *classification* of the *dam*. In addition, the understanding of the natural hazards imposed on the *dam* is continuously evolving and

technical methodologies for *dam safety analyses* are continuously developing as new knowledge is acquired in various aspects of *dam* safety. Changes beyond the control of the *dam owner* can include changes in the state of knowledge concerning natural hazards, changes in the operating regime of the *dam* resulting from new demands for power or water or storage capacity and changes to the inflow into the reservoir as a result of changes to the operating regime of upstream *dams*. The condition of the *dam* itself could change over time as the *dam* ages and the *dam* material and equipment deteriorate.

The *Qualified Professional Engineer* cannot foresee and cannot be expected to forecast the impact of potential future changing conditions on the assessment of the safe operation of the *dam* for a specific *dam safety review*. The *dam safety review* should assess the *dam* in its current state and environment using the current state of practice for *dam safety analysis*. However, if it is clear during the review process, that imminent changes are to be made, or are in the process of being made, to the *dam* or the *dam's* environment, the *Qualified Professional Engineer* should assess the impact of these changing conditions on the safe operation of the *dam* in the immediate future and document these impacts in the *dam safety review report*. Examples of changing conditions that are planned or actual include changes to downstream development that would possibly change the *classification* of the *dam* or imminent construction of safety improvements to the *dam* aimed at resolving prior deficiencies.

The *dam safety review* ~~cannot~~ ~~does~~ considers the impacts of climate change on the safety status of the *dam* at the time of the dam safety review report.~~within the period for which the *dam safety review report* is validbecause~~not withstanding~~ Notwithstanding, ~~that~~the period of time of the validity of the dam safety review report is very short in comparison to the multiple decades over which climate change effects materialize. ~~.~~

3.7 *DAM SAFETY REVIEW REPORT*

Written reports are the means by which the *Qualified Professional Engineer* communicates the results of his/her *dam safety review* to the *client* and, along with *the Dam Safety Review Assurance Statement*, to the *regulatory authority*. Report formats will vary depending on the complexity of the *dam safety review* and level of service. The *Qualified Professional Engineer* should consider reviewing the format and content of the *dam safety review report* with the *client* prior to finalizing the report.

While the structure and composition of the report is largely the *Qualified Professional Engineer's* responsibility, there is some documentation that is required to be included into the *dam safety review report* to allow the *Qualified Professional Engineer's* work to be replicated and made transparent to understanding how the *Qualified Professional Engineer* arrived at his/her conclusions and recommendations. Typically, a *dam safety review report* should include the following:

- executive summary highlighting the key conclusions and recommendations;
- introduction which defines purpose of the *dam safety review* and the scope of services of the *Qualified Professional Engineer*;
- general description of the *dam* and related structures, including the general arrangement, design and construction history, recent history of the *dam* since the previous *dam safety review*, the assessment of the *classification* of the *dam* in the

present environment, and descriptions of the flood, seismic reservoir and slope stability hazards;

- a summary of the finding of the previous *dam safety review*, if any, and any actions taken since the previous *dam safety review* to rectify deficiencies and non-conformances;
- the identification of the external and internal hazards and failure modes and compilation of these hazard and failure mode pairs into a hazards and failure modes matrix;
- a summary of the *owner's* compliance with the regulatory requirements;
- the details of the assessment of each component of the *dam* including the reservoir or impoundment (mining *dams)*, giving a general description of the component, the monitoring and performance of the component over the period since the previous *dam safety review*, if any, and any deficiencies and non-conformances identified during the assessment of the particular component;
- the details of the assessment of the operations, maintenance and surveillance practices at the *dam* including the assessment of the overall *dam* safety management system and identification of any non-conformances;
- the details of the review of the emergency planning, including documentation and training of personnel and testing of the emergency plans, and identification of any non-conformances;
- identify information that was not available;
- the details of all design assumptions;
- a summary of design calculations performed to support the technical analyses;
- the conclusions and recommendation of the *dam safety review* including the key findings, prioritized list of deficiencies and non-conformances, and recommended actions to be taken to correct any hazardous conditions identified during the *dam safety review* at the *dam; and*
- the "shelf life" of the *dam safety review report* (see Section 3.8).

Supporting documents, such as the site visit report, can be included in appendices. *Dam safety review reports* should be accompanied by drawings, figures, sketches, photographs, other tables and/or other support information as required. Graphic information should be consistent with the information in the text.

The *dam safety review report* should be clearly written with sufficient detail to allow the *client, regulatory authority* and others reviewing the *dam safety review report* to understand the methods, information used and supporting rationale for conclusions and recommendations, without necessarily visiting the *dam* site.

A peer review of the *dam safety review report*, prior to its submission to the *client*, is strongly encouraged as part of the quality assurance/quality control program (refer to Section 4.0).

3.8 LIMITATIONS AND QUALIFICATIONS IN *DAM SAFETY REVIEWS*

Most consulting firms have their standard limitations that are routinely included in reports. However, for *dam safety reviews*, a number of other limitations will be unavoidable. The original design and construction, design upgrades and any other safety assessments done on the *dam* in the past are likely done by other professionals and the only evidence of this previous work, is in the form of reports. The *Qualified Professional Engineer* has to review and interpret the data provided in these existing reports, to form an opinion on the current safety status of the *dam*. Reliance on work performed by other professionals in the past is therefore used in the *dam safety review* and the *Qualified Professional Engineer* may wish to include limitations and qualifications in the *dam safety review report* where he/she has relied on the previous work by other professionals.

In addition, the determination of the flood and seismic hazards are usually carried out independently of the *dam safety review* by specialists in the respective fields. This work is highly specialised and it is usually not possible for the *Qualified Professional Engineer* to be expected to accept responsibility for the determination of these natural hazards. Therefore in most cases, the *Qualified Professional Engineer* must rely on the work done by others to define the natural hazards on the *dam* and the *dam safety review report* should be qualified to this regard.

A *dam safety review report* is not intended to reflect the safety status of the *dam* for any significant time in the future. The report documents the current safety status of the *dam*. The *client* and the *Qualified Professional Engineer* should attempt to anticipate reasonable changes to the environment in which the *dam* system is located. These could include such things as possible downstream development and changes that could occur in the condition of the *dam* over a short period of time in the future, such as deterioration of flow control equipment. In the case of mining *dams*, such changes may include modifications to the processing plant, expansion of production or impending closure. The “shelf life” of the *dam safety review report* is limited and so it should be identified that its currency is only for the *dam* at the time that the *dam safety review* was conducted.

Limitations and qualifications, including those associated with background information, assumptions, sources of error, ranges of values and subjective opinions, should be described clearly in the *dam safety review report*.

3.9 FOLLOW-UP TO *DAM SAFETY REVIEW REPORTS*

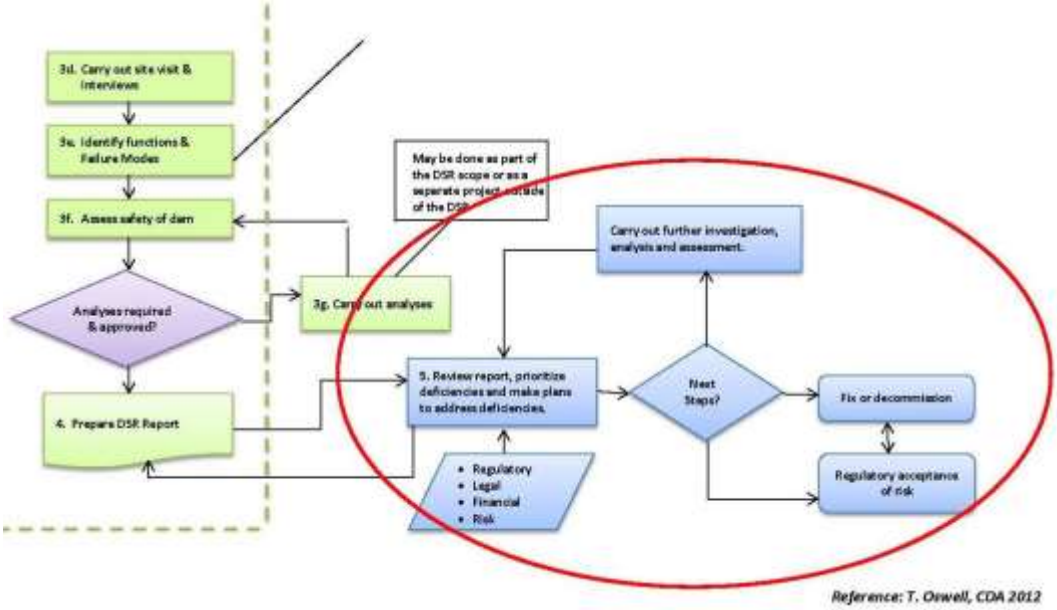
If deficiencies exist that compromise the safety of the *dam*, these must be addressed. A *dam* must not be permitted to remain in such a state that it imposes an unacceptable risk to people or property or fails to meet required safety criteria. Reducing the risk to tolerable levels may be done either by reducing the consequences or reducing the risk of failure. Where financial constraints do not allow immediate corrective actions, measures such as reduced reservoir or impoundment levels may be implemented until the necessary corrective actions can be undertaken. Other early actions may range from enhanced monitoring, additional instrumentation, or other operational changes. Some findings which typically warrant follow-up are captured in Section 4.0 of the 2007 *CDA Dam Safety Guidelines*.

The *dam safety review report* will document the deficiencies and other *dam* safety issues found. The *dam owner* must then prioritize and provide a plan to resolve the deficiencies and issues within the appropriate regulatory, legal, financial and risk framework. This follow-up may be included as a subsequent phase or separate project, but is not typically included in the scope of a *dam safety review*. A partial list of these issues follows:

- *Owner's Dam* Safety Management System
  - Overall *dam* safety planning;
  - Prioritization of concerns and decision process;
  - *Owner's* values and organizational structure;
  - Roles and responsibilities;
  - Mitigating actions - defense of depth, corrective and/or protective measures;
  - Operational and surveillance activities;
  - Emergency preparedness and response.
- *Dam* Safety Improvements
  - Risk assessment – indication of threat the *dam* represents to the public or the environment;
  - Assessment of deficiency and corrective action;
  - Implementation of required upgrades (interim and longer term actions);
  - Operational improvements – advanced drawdown, conservative rule curves, flash board/stoplog removal;
  - Surveillance improvements – increased frequency/situational (enhanced attendance during floods) inspections, additional instrumentation.

Typical follow-up steps to a *dam safety review* are depicted below in Figure 6.

Figure 6: Follow-up Steps to a *Dam Safety Review*


3d. Carry out site visit & interviews
3e. Identify functions & Failure Modes
3f. Assess safety of dam
Analyses required & approved?
3g. Carry out analyses
May be done as part of the DSR scope or as a separate project outside of the DSR
Carry out further investigation, analysis and assessment.
4. Prepare DSR Report
5. Review report, prioritize deficiencies and make plans to address deficiencies.
Next Steps?
Fix or decommission
Regulatory acceptance of risk
Regulatory
Legal
Financial
Risk
Reference: T. Orwell, CDA 2012

4.0 QUALITY ASSURANCE/QUALITY CONTROL

A *Qualified Professional Engineer* must carry out quality assurance/quality control (QA/QC) during all phases of a *dam safety analysis* as part of the preparation of a *dam safety review report*. The Assurance Statements in Appendix D include confirmation that in preparing the *dam safety review* report the intent of *APEGBC's* quality management bylaws have been met.

4.1 *APEGBC* QUALITY MANAGEMENT REQUIREMENTS

Qualified Professional Engineers are obligated to abide by the quality management requirements under the *Engineers and Geoscientists Act* and Bylaws. In order to meet the intent of the requirements, *Qualified Professional Engineers* shall establish and maintain documented quality management processes for their practices which shall include as a minimum;

- The application of the relevant *APEGBC* Professional Practice Guidelines
    - *Engineers and Geoscientists Act*, s. 4(1) and Bylaw 11(e)(4)(h)
    - When carrying out *dam safety reviews*, a *Qualified Professional Engineer* must have sufficient broad based knowledge of, and experience in, these guidelines.
- Retention of complete project documentation – Bylaw 14(b)(1)
    - When carrying out *dam safety reviews*, the *Qualified Professional Engineer* must meet the intent of the *APEGBC Quality Management Guidelines – Retention of Project Documentation*
- Regular, documented checks using a written quality control process – Bylaw 14(b)(2)
    - When carrying out *dam safety reviews*, the *Qualified Professional Engineer* must meet the intent of the *APEGBC Quality Management Guidelines – Documented Checks of Engineering and Geoscience Work*
- Documented field reviews of projects during implementation or construction – Bylaw 14(b)(3)
    - When carrying out *dam safety reviews*, the *Qualified Professional Engineer* must meet the intent of the *APEGBC Quality Management Guidelines – Documented Field Reviews During Implementation or Construction*. For example, if the *Qualified Professional Engineer* makes specific recommendations in the *dam safety review report* regarding the implementation or construction of remedial engineering works, the *Qualified Professional Engineer* has an obligation to see that the *client* is informed in writing that those works must be carried out by or under the direct supervision of a *professional engineer*. Upon confirmation of this, the *Qualified Professional Engineer* would place this document in their file. If no such confirmation is provided then the *Qualified Professional Engineer* must refer to Section 3.7 of the *APEGBC Quality Management Guidelines – Documented Field Reviews During Implementation or Construction*.
- Documented independent review of structural designs – Bylaw 14(b)(4)
    - If structural analysis is carried out as part of a *dam safety review*, an independent review must be carried out on the analyses/calculations. The extent of the independent review is to be determined by the reviewer. The *Qualified*

Professional Engineer must meet the intent of the *APEGBC Quality Management Guidelines – Documented Independent Review of Structural Designs*.

- Authentication of professional documents by the application of the *Qualified Professional Engineer's* professional seal – Act, s.20(9)
    - The *Qualified Professional Engineer* must apply their professional seal to *dam safety review reports* prepared in their professional capacity or under their direct supervision and the *Qualified Professional Engineer* or the lead *Qualified Professional Engineer* must apply their seal to the *Dam Safety Review Assurance Statement*. The *Qualified Professional Engineer* must meet the intent of the *APEGBC Quality Management Guidelines – Use of the APEGBC Seal*
- Professional engineering activities can only be delegated to subordinates under direct supervision – Act s 1(1) and 20(9)
    - If certain aspects of the *dam safety review*, such as field work, are delegated to non-professionals or other subordinate engineers, they must be carried out under direct supervision of the *Qualified Professional Engineer*. The *Qualified Professional Engineer* assumes full responsibility for all work delegated.

4.2 Direct Supervision

The *Engineers and Geoscientists Act* (Section 1(1)) states that direct supervision means taking responsibility for the control and conduct of the engineering or geoscience work of a subordinate. With regard to direct supervision, the *Qualified Professional Engineer* having overall responsibility should consider:

- the complex nature of the *dam* being reviewed and the nature of the values at risk;
- which aspects of the *dam safety analysis*, and how much of those aspects, may be delegated;
- training and experience of individuals to whom work is delegated; and
- amount of instruction, supervision and review of the subordinate is required.

Field work is one of the most critical aspects of a *dam safety analysis*. Therefore, careful consideration must be given to delegating field work. Due to the complexities and subtleties of *dam safety analysis*, direct supervision of field work is difficult and care must be taken to see that delegated work meets the standard expected of the *Qualified Professional Engineer*. Such direct supervision could typically take the form of specific instructions on what to observe, check, confirm, test, record and report back to the *Qualified Professional Engineer*. The *Qualified Professional Engineer* should exercise judgment when relying on delegated field observations by conducting a sufficient level of review to be satisfied with the quality and accuracy of those field observations.

4.3 Checking and Review

As referenced in Section 4.1 of these guidelines and consistent with the requirements of *APEGBC* Quality Management Bylaw 14(b)(2), as a minimum, a *dam safety review report* must undergo a documented checking and review process before being finalized and delivered to the *client* and/or the *regulatory authority*. This documented checking and review process would normally involve an internal review by another *Qualified Professional Engineer* within the same firm. Where an appropriate internal reviewer is not available, an external reviewer may be engaged or where this is not practical it may be appropriate, based on the elements at risk, to have the *Qualified Professional*

Engineer who originally prepared the report check the report at a point removed in time. Where an internal/external review has been carried out this must be clearly documented in the *dam safety review report*. The level of review should be discussed with the *client* and the relevant *regulatory authority* but is based on the professional judgment of the *Qualified Professional Engineer*. Considerations should include the complexity of the site, the nature of the *dam*, elements at risk, availability, quality and reliability of background information and field data, the degree of judgment, on which the assessment is based, and the *Qualified Professional Engineer's* training and experience.

4.4 Independent Peer Review

An independent peer review is an additional level of review beyond the minimum requirements of Bylaw 14(b)(2) that may be undertaken for a variety of reasons (such as those listed in section 4.3) by an independent *Qualified Professional Engineer* not previously involved in the project. At the discretion of the *Qualified Professional Engineer*, in consultation with the reviewer(s) involved in the regular checking/review process outlined above, such an additional level of review may be deemed appropriate. Alternatively, a local government or other approving authority may request an independent peer review to support project approval. An independent peer review may be undertaken by another *Qualified Professional Engineer* within the same firm, or an external *Qualified Professional Engineer*.

The independent peer review process should be more formal than the checking/review process carried out under Bylaw 14(b)(2). An independent peer reviewer should submit a signed, sealed and dated letter or report, to be either included with the *dam safety review report* or put on file, which includes the following:

- limitations and qualifications with regard to the independent peer review; and
- results of the independent peer review.

When an independent peer review is carried out, the ~~*Qualified*~~ *Professional Engineer* who signed the *dam safety review report* remains the ~~Engineer of Record~~*Qualified Professional Engineer*.

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The independent peer review discussed above is not the same as an independent review or advisory service provided by a *Qualified Professional Engineer* who is retained by the *regulatory authority*, or sometimes a *client*.

5.0 PROFESSIONAL REGISTRATION; EDUCATION, TRAINING AND EXPERIENCE

5.1 PROFESSIONAL REGISTRATION

The following is the professional registration requirements for a *Qualified Professional Engineer* performing *dam safety reviews* for *dams* in British Columbia which are addressed in these guidelines:

> *Dam Safety Regulation* indicates that *dam safety reviews* must be carried out by a *professional engineer* "with qualifications and experienced in *dam safety analysis*".
>
> *CDA Dam Safety Guidelines* form the basis for *dam safety reviews* required by the *Mines Act* permit conditions. The *CDA Dam Safety Guideline*s states that "*dam safety reviews* should be carried out by, or under the direction of, a registered professional engineer with a background in design, construction, performance analysis, and operation of *dams*."

A *Qualified Professional Engineer* as described above must be a person registered, and in good standing with *APEGBC*, as a *professional engineer* under the *Engineers and Geoscientists Act*. The *Qualified Professional Engineer* is typically registered with *APEGBC* within the discipline of structural, civil, geological or mining engineering. As the complexity of the *dam* and site conditions increase, the characterization and sound understanding of the hazard and failure mode processes becomes more critical. Not all *professional engineers* registered in the disciplines noted above are *Qualified Professional Engineers* in *dam safety reviews*. It is the responsibility of the *professional engineer* to determine whether he/she is qualified by training or experience to undertake and accept responsibility for *dam safety reviews* for proposed *dam* and site conditions (*APEGBC* Code of Ethics Principle 2) and should meet the intent of the requirements that follow.

5.2 EDUCATION, TRAINING AND EXPERIENCE

A *dam safety review*, as described in these guidelines, requires minimum levels of education, training and experience in many overlapping areas of engineering and geoscience. A *Qualified Professional Engineer* must adhere to *APEGBC* Code of Ethics Principle 2 (to undertake and accept responsibility for professional assignments only when qualified by training or experience), and, therefore, must evaluate his/her qualifications and possess appropriate education, training and experience consistent with the services provided.

When applying the guidance provided in this section the level of education, training and experience required for a *dam safety review* should be commensurate with the complexity of the *dam* system and the *dam classification*.

Education, training and experience can vary depending on the *Qualified Professional Engineer's* background and whether specialty services are being provided. Whether carrying out a *dam safety review* or providing specialty services, appropriate experience can only be gained by working under the direct supervision of a suitably knowledgeable and experienced *Qualified Professional Engineer*.

Depending on the size and complexity of the *dam* and site conditions, *dam safety reviews* may be carried out by an individual *Qualified Professional Engineer* or a multidisciplinary team of professionals lead by an experienced lead *Qualified Professional Engineer.* The recommended minimum qualifications for these two positions follow.

Prior to conducting a *dam safety review*, an individual *Qualified Professional Engineer* or a lead *Qualified Professional Engineer* must:

- be knowledgeable in the design, construction, performance analysis and operations of *dams*;
- be knowledgeable about the *Dam Safety Regulation* and applicable legislation;
- in the case of mining *dams,* be knowledgeable about the regulations applicable to the *Mines Act* and the *Health, Safety and Reclamation Code for Mines in British Columbia*;
- be knowledgeable about the various technical *dam* safety guidelines, specifically the *CDA Dam Safety Guidelines* and associated technical bulletins;
- be knowledgeable about the system approach to *dam safety analysis* required for the review; and
- confirm that he/she has the appropriate training and experience to conduct the *dam safety review* associated with the particular type of *dam* and complexity of the associated overall *dam* system of containment of the reservoir and conveyance of the river flows past the *dam*, and if not, involve the required specialists to provide assistance in the relevant areas.

Individual *Qualified Professional Engineer*
Minimum qualifications for an individual *Qualified Professional Engineer* carrying out the *dam safety review,* is as follows:

- Current registration with *APEGBC* as a *professional engineer*.
- Previous involvement with at least three *dam safety reviews*.
- Have at least 15 years of related experience in design, construction, performance evaluation and/or operation of *dams*.
- Current knowledge of the *Dam Safety Regulation*, *CDA Dam Safety Guidelines* and other international *dam* safety standards.
- In the case of mining *dams,* current knowledge of the regulations applicable to the *Mines Act* and the *Health, Safety and Reclamation Code for Mines in British Columbia*, and the *CDA Dam Safety Guidelines*.
- Not participated in the design, construction, safety management (surveillance, deficiency investigation, capital improvement) on the specific *dam* in question.

Lead *Qualified Professional Engineer* for a multidisciplinary team
Minimum qualifications for a lead *Qualified Professional Engineer* coordinating a multidisciplinary team of professionals for a *dam safety review,* is as follows:

- Current registration with *APEGBC* as a *professional engineer*.

- Previous involvement with at least two *dam safety reviews*, as lead technical person or under the direct supervision of a suitably knowledgeable and experienced *Qualified Professional Engineer*.
- Have at least 10 years of related experience in design, construction, performance evaluation and/or operation of *dams*.
- Current knowledge of the *Dam Safety Regulation*, *CDA Dam Safety Guidelines* and other international *dam* safety standards.
- In the case of mining *dams,* current knowledge of the regulations applicable to the *Mines Act* and the *Health, Safety and Reclamation Code for Mines in British Columbia*, and the *CDA Dam Safety Guidelines*.
- Not participated in the design, construction, safety management (surveillance, deficiency investigation, capital improvement) of the specific *dam* in question.

Under the multidisciplinary team approach, the lead *Qualified Professional Engineer* may have less experience than an individual *Qualified Professional Engineer* as he/she is supported by a team of *Qualified Professional Engineers* and specialists. However, the lead *Qualified Professional Engineer* is expected to direct and be involved throughout the *dam safety review* process.

Qualified Professional Engineers
Minimum qualifications for all *Qualified Professional Engineers* who carry out *dam safety reviews* whether as an individual, as a lead *Qualified Professional Engineer* or as a specialist team *member*, must have the appropriate education, training and experience that specifically encompasses the area of expertise required of them. It is the *Qualified Professional Engineer's* obligation to have and document their education, training and experience to be able to practice and maintain their competency in this field.

As previously noted, as the complexity of the *dam* and site conditions increases, and depending on the location in the province, the minimum qualifications should be supplemented by training and experience in additional subject areas, as required. Specialists may have to be retained to supplement experience in some of these areas and provide the necessary range of disciplines necessary for the specific *dam* and site conditions.

The academic training for the above skill sets can be acquired through formal university or college courses, or through continuing professional development. There may be some overlap in courses and specific courses may not correlate to specific skill sets. A *Qualified Professional Engineer* should also remain current, through continuing professional development, with the evolving topics of *dam* safety, surveillance, construction, rehabilitation and other specialized services offered (refer to *APEGBC* Code of Ethics Principle 6). Continuing professional development can include taking formal courses; attending conferences, workshops, seminars and technical talks; reading new texts and periodicals; searching the web; and participating in field trips.

5.3 Specialty Services

As the complexity of the *dam* and site conditions increase, so does the need for a multi-disciplinary team approach to the delivery of a *dam safety review*. It may be the case that it is neither expected nor reasonable that any given *Qualified Professional Engineer* has a broad enough education and experience to address all of the components of a

dam safety review. Depending on the facility characteristics (including upstream and downstream conditions), background of the *Qualified Professional Engineer* and skill sets of the *dam safety review* team, specialty services may be required, such as inundation studies; seismic determination and response; concrete technology; or instrumentation.

A specialist who offers specialized services may require specific education, training and experience in addition to that, discussed in Section 5.2. The *Qualified Professional Engineer* engaging the specialist has a responsibility to confirm that the specialist has the appropriate skills and competencies required to complete the activity they are engaged to carry out.

6.0 REFERENCES AND RELATED DOCUMENTS

Not all the following documents are referenced in the text or appendices. Some are related sources of useful information. Where documents are known to be available on the world wide web, they are noted as [web].

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Hartford, DND, and G.B. Baecher (2004). Risk and Uncertainty in Dam Safety. Thomas Telford.

International Boundary Water Treaty Act, Revised Statutes of Canada 1985, Chapter I-17. [web]

International Commission on Large Dams (ICOLD) (2000). Bulletin 124, Reservoir Landslides: Investigation and Management, Guidelines and Case Histories.

International Commission on Large Dams (ICOLD) (2005). Bulletin 130, Risk Assessment in Dam Safety Management, a Reconnaissance of Benefits, Methods and Current Applications.

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Ministry of Forests, Lands and Natural Resource Operations, Water Stewardship Division (2010). Dam Safety Inspection Checklist - for Dam Safety Reviews (Excel file) [web]

Natural Research Council of Canada (2010). National Building Code of Canada.

National Resources Canada, Geological Survey of Canada (2005). Open File 4459, Fourth generation Seismic Hazard Maps of Canada; Values for over 650 Canadian Localities intended for the 2005 National Building Code of Canada. J. Adams and S. Halchuk. [web]

Natural Resources Canada. Determine 2010 National Building Code of Canada Seismic Hazard Values. [web site: http://www.earthquakescanada.nrcan.gc.ca/hazard-alea/interpolat/index_2010-eng.php]

APPENDIX A: LEGISLATIVE FRAMEWORK – WATER RESERVOIR *DAMS*

The regulation of water reservoir *dams* and issue of water licenses in British Columbia is a provincial responsibility and the *Water Sustainability Act* ([SBC 2014] CHAPTER 15), and the associated regulation, the *Dam Safety Regulation*, is the statute and regulation that governs *dam* safety in British Columbia.

The *dam owner* has the responsibility for carrying out *dam safety reviews* on their *dams* for certain *classifications* and at the intervals provided by the *Dam Safety Regulations.*

Several rivers in British Columbia flow across the international border with the United States of America. The International Joint Commission (IJC) was established by the governments of Canada and the USA under the *Boundary Water Treaty* of 1909. The mandate of the IJC is to try to prevent or to resolve disputes involving waters in rivers common to both countries. The IJC has set up Boards to help them carry out their duties. Although the IJC has no direct mandate to deal with the regulation of *dam* safety in British Columbia, certain operating parameters of some *dams* in Canada which are on the affected rivers, are set by the IJC. In British Columbia, some of these *dams* are on the Columbia, Kootenay and Osoyoos Rivers.

The Columbia River Treaty was signed by Canada and the USA in 1964 and is an international *agreement* between the two countries to coordinate flood control and to optimize hydroelectric energy production on both sides of the border. On the Canadian side of the border, the *dams* under the Columbia River Treaty are Mica Dam, Keenleyside Dam and Duncan Dam. Operation of these *dams* is dictated by the requirements of the treaty. The Columbia River Treaty does not have any direct influence on *dam* safety aspects of these *dams* with the exception of the operation of these *dams*.

When starting a *dam safety review*, the *Qualified Professional Engineer* should determine whether or not the operations of the particular *dam* are affected by any orders issued by the IJC or whether or not the *dam* falls within the ambit of the Columbia River Treaty.

The *Water Sustainability Act* of British Columbia contains very little detail that affects *dam* safety. The *Dam Safety Regulation* specifically addresses the responsibilities of the *Dam Owner* for the safe operation of a *dam* and prescribes documentation requirements, such as OMS Manuals and Dam Emergency Plans for the *dam*. It also prescribes surveillance activities, *dam safety reviews* and operational testing of flow control equipment. The *Dam Safety Regulation* includes the determination of the *classification* of *dams* based on the consequences of a postulated failure of the *dam*. *The Dam Safety Regulation* does not contain any specific technical details pertaining to *dam* safety engineering.

The *CDA Dam Safety Guidelines* and associated technical bulletins, first issued in 2007, provides guiding principles for the management of *dams* and the technical bulletins suggest methodologies and procedures for use by *professional engineers* as they carry out *dam* analyses and safety assessments. The *CDA Dam Safety Guidelines* were developed by working groups of the CDA who represented a cross section of *dam* engineering professionals across Canada. The *CDA Dam Safety Guidelines* have no legal status and the *Dam Safety Regulation* takes precedence over the *CDA Dam Safety Guidelines*. However, the *CDA Dam Safety Guidelines* are considered to be the principal technical document in Canada for conducting *dam safety reviews*.

APPENDIX B: MINING *DAMS* – CONSIDERATIONS IN *DAM SAFETY REVIEWS*

INTRODUCTION

Mining *dams* include structures that impound contaminated water and/or tailings or acid generating waste rock, or water treatment sludge and require additional considerations with respect to *dam safety reviews*. This Appendix identifies the key considerations which include: Construction, Operations and Closure; Environmental; and Regulations.

Tailings *dams* and other mining *dams* can be evolving structures and this should be taken into account when establishing the appropriate frequency of *dam safety reviews*. A *dam safety review* should also be carried out when there is a substantive change in the operation of a mining *dam*, if there are significant changes occurring downstream, or if applicable regulations change.

The *CDA Dam Safety Guidelines* (CDA Ref.1) includes a section that details the information that is required for completing a formal *dam safety review*. The supplemental bulletin, Application of Dam Safety Guidelines to Mining Dams (CDA Bulletin Ref. 2) explains how the requirements for a *dam safety review*, in the *CDA Dam Safety Guideline*, are applicable to mining *dams* in the "Operation Phase". In addition, the mining *dams* Bulletin addresses aspects of *dam safety reviews* that are relevant to closure including "Closure - Transition Phase", "Closure - Active Care Phase" and "Closure - Passive Care Phase".

The *dam safety review* for mining *dams* should be carried out by a *Qualified Professional Engineer* or multidisciplinary team of *professional engineers* reporting to the *Qualified Professional Engineer* who is a registered *professional engineer* with *APEGBC* and has the necessary education, training and experience detailed in Section 5.0 of these guidelines with particular experience related to the design, operation and management of mining *dams*. In addition, the *Qualified Professional Engineer* must have current knowledge of the *Health, Safety and Reclamation Code for Mines in British Columbia* and the permit conditions under the *Mines Act* applicable to the *dam* or *dams* being reviewed. The *Qualified Professional Engineer* should also have current knowledge of the *CDA Dam Safety Guidelines*, the associated CDA Technical Bulletin for mining *dams* and other international *dam* safety standards.

The *CDA Dam Safety Guidelines* (and the associated Bulletin for mining *dams*) focuses on the structural failure modes of a *dam* (sliding, overtopping, internal erosion, etc.). However, there are other failure modes associated with mining *dams* that are non-structural in nature and related to environmental protection.

Guidance on tailings *dam* design; management; operations, maintenance and surveillance; and, closure are provided in guidelines developed by the International Commission on Large Dams (ICOLD- Ref. 8 and Ref. 9) and the Mining Association of Canada (Ref. 10, Ref. 11 and Ref. 12).

CONSTRUCTION, OPERATIONS AND CLOSURE

Mining *dams* are often constructed with a "starter" *dam* and raised over the life of the mine to store the waste products. The *dams* are also subject to on-going changes during the life of the mine and over the long term for closure conditions. The *dam safety review* should consider the unique aspects of the facility, which include, but are not limited to the following:

Mining *dam* design sections vary from *dams* constructed almost entirely of tailings to conventional earth/rockfill *dams*. Some of the unique aspects which could be considered include:

- Cyclone sand *dams*: The cyclone sand should be suitable for placement and, if required, compaction. Loose, saturated cyclone sand susceptible to liquefaction under seismic loading should not be placed within the *dam* embankment.
- Upstream *dams*: Adequate segregation of the spigotted tailings is required and underdrains should be provided to control the phreatic surface to mitigate the potential for static liquefaction. Adequate density and/or drainage is required to mitigate the potential for liquefaction under seismic loading.

Water management systems of tailings facilities are constructed and managed to contain mine contact (contaminated) water, divert non-contact water and manage water inflows and recycle of water to the process plant. Some of the unique considerations could include:

- The water balance should be managed to provide storage for operational water, and seasonal inflows, while providing storage for the Environmental Design Flood (EDF) and freeboard.
- The Inflow Design Flood (IDF) should be managed by providing storage within the impoundment or through the construction of temporary spillways to route the flood. Adequate storage capacity is required in the event of failure of diversion structures during the design event. The temporary spillways should have adequate capacity to route the IDF.
- If decants are used they should operate according to the design and there should be adequate capacity for the design flood event.

A very important design aspect of mining *dams* is the objective of minimizing the long term liability associated with closure of the facility. *Dam safety reviews* are required for both operating *dams* and closed *dams* and some of the unique considerations include:

- The *dam* design criteria (flood and seismic) should be appropriately updated to reflect the increased risk of the long term closure time period as outlined in the *CDA Mining Dams Bulletin*.
- The *dam* design should be amenable to closure or design measures should be implemented during operations to reduce the risks upon closure.
- The development of new settlements downstream of the *dam* should be considered as this could change the *dam* consequence *classification*.
- Long term geochemical actions that could lead to exceedance of the water quality design components should be considered.

Environmental

Mining *dams* typically store contaminated water and/or solids. Consequently, the *dam safety review* needs to appropriately consider if the *dam* is meeting the environmental objectives of its design. Environmental design criteria should be clearly documented and should include the "allowable" seepage rate, the Environmental Design Flood (EDF) and the water flow and water quality requirements for any release of surface water. The main components that need to be assessed in the *dam safety review* include, but are not limited to, the following:

- The properties of contaminants of potential concern (COPCs). These could include parameters such as pH, metal and metalloid concentrations, total suspended solids, etc. During mine operations the concentrations of certain parameters may increase due to recycling of water and input from leached mine rock. Unless considered in the original design, the increase in concentrations may require additional seepage mitigation or water discharge/treatment facilities.
- The efficiency of seepage mitigation. This could include assessment of the seepage rate and efficiency of seepage mitigation works, which may include: grout curtains, low hydraulic conductivity core zones or impoundment lining, geomembrane or geosynthetic clay liners, seepage interception ditches or seepage pump-back wells, etc.
- Water releases and risks of water release. Water releases can be via groundwater or direct discharge. Monitoring of groundwater wells downstream of the facility provides an indication of potential contaminant migration and can be used to estimate and confirm potential seepage rates. Tracking of parameters which attenuate very little (such as sulphate) provide an early indication of seepage effects. Surface water releases must meet site specific and/or regulatory discharge water quality criteria, which may also include allowable assimilative capacity of the receiving environment.
- Environmental flood containment. The water balance of the impoundment should be assessed to assure that there is adequate freeboard to store the EDF.
- For some facilities, dust can be generated from tailings sand *dams* which can be a public health and environmental concern. Accordingly, the *dam safety review* should assess if the dust mitigation measures are meeting the design objectives.

In 2009, Environment Canada issued an *Environmental Code of Practice for Metal Mines* (EC Ref.3). This document provides a series of recommended environmental practices pertinent to mining *dams* throughout the life of a mining *dam*. The focus of the code of practice document is on metal mines (including uranium). The document can be used to assist with defining the objectives and criteria for mining *dams* with respect to environmental protection requirements.

REGULATIONS

The management and safe operation of *dams* constructed for impoundments on a mine site is the responsibility of the *owner*. Authorization to construct and operate an impoundment and associated *dams* on mine sites in British Columbia is provided in a *Mines Act* permit issued by the Ministry of Energy and Mines. The permit includes conditions under which the impoundment and *dams* are to be operated and managed.

The design, construction and operation of *dams* on a mine site in British Columbia are covered by regulations and requirements under the *Mines Act* (Ref.4) and the *Health, Safety and Reclamation Code for Mines in British Columbia* (Code Ref.5). *Dams* on a mine site that require a water licence are also subject to regulations under the *Water Act* (ref.6).

A Memorandum of Understanding (MOU Ref.7) specifies the responsibilities for the regulation of impoundments, diversion structures at a mine site. The individual and joint responsibilities for the various impoundments and *dams* constructed on a mine site are shown in Table B~~C~~-1. The purpose of the MOU is to define the role of the Ministry of Energy and Mines, the Ministry of Forests, Lands and Natural Resource Operations, and the Ministry of Environment in the siting, design, construction, operation, maintenance, abandonment, reclamation and regulation of

impoundments and diversions on a mine site, in order to protect the public, the environment, and the users of water in the affected watershed.

Table BC-1: Regulatory responsibility for impoundments, *dams* and diversions on a mine site

Type of impoundment	Ministry of Energy and Mines**	Ministry of Forests, Lands and Natural Resource Operations	Joint responsibility if water licence required
Tailings Storage Facility	✓		✓
Flooded Impoundment	✓		✓
Water Storage Facility		✓	
Sedimentation Control Pond	✓		✓
Sludge Pond	✓		✓
Diversion *Dams* and Channels		✓	
Impoundment requiring a water licence		✓	

** Additional requirements may need to be satisfied for facilities that are not checked under the responsibility of the Ministry of Energy and Mines in the table above but are otherwise defined as "major *dams*" or "major impoundments" as per the *Health, Safety and Reclamation Code for Mines in British Columbia*.

The BC *Health, Safety and Reclamation Code for Mines in British Columbia* *HSRC Guidance Document (2016)* includes guidance on design standards for tailings storage facilities TSFs. Section 10.5.3 of the *Health, Safety and Reclamation Code for Mines in British Columbia* *HSRC* requires that "tailings storage and water management facilities and associated dams shall be inspected annually and a report shall be prepared by the EOR in consideration of the HSRC Guidance Document" a *dam* safety inspection and subsequent report be completed every year for all tailings and water management facilities and associated *dams*. The requirement for an annual *dam* safety inspection is in addition to the formal *dam safety review* that is required at least every five years as referenced in section 10.5.4 of the Health, Safety and Reclamation Code for Mines in British Columbia.HSRC

All major *dams* require an Operation, Maintenance and Surveillance manual that should specify the frequency for undertaking formal *dam safety reviews*. In addition, section 4.3 of the HSRC requires Section 4.3 of the *Health, Safety and Reclamation Code Guidance Document* states that the Code requires that an emergency preparedness and response plan for TSFs tailings storage facilities be documented, updated annually and tested on a frequency suitable for its consequence classification for response and recovery from specific incidents."

A *dam safety review* is required for tailings dams dams at a minimum of every five every five years, regardless of consequence classification (Section 4.6, HSRC Guidance Document). Tailings storage facilities that do not impound water are also subject to periodic safety reviews. For other mining dams, a *dam safety review* is required based on the *dam* failure consequence *classification* determined for the *dam* and the frequency specified in the *CDA Dam Safety Guidelines* as shown in Table C-2. It should be noted that these frequencies differ somewhat from those outlined in the *Dam Safety Regulation*.Although CDA recommends a frequency for conducting Dam Safety Reviews based on the consequence classification, the BC Code requirements must be met for dam safety reviews in BC.

Table C-2: Suggested Frequency *for Dam Safety Reviews* (Reproduced from the *CDA Dam Safety Guidelines*)

Dam Classification	Frequency
Extreme	Every 5 years
Very High	Every 5 years
High	Every 7 years
Significant	Every 10 years
Low	Note 1
Note 1. A *dam safety review* is not required for low consequence *dams*. However, the consequences of failure should be reviewed periodically, since they may change with downstream development. If the *classification* increases, a *dam safety review* is required at that time.	

ENGINEER OF RECORD

Mining *dams* often evolve over time with a long and complex design, construction and operational history. Also, there can be frequent changes among the mining company personnel that are responsible for the safety of the *dams* and the "Engineer of Record" (*EOR*) provides the continuity between personnel. In addition, ownership changes can result in changes to staff responsible for *dam* safety. The concept of *EOR* is an important consideration for mining *dams* as there can often be several engineers and engineering firms involved in the design and construction of a single mining *dam* over its life and it may not be clear who the *EOR* is for the *dam*. For each *dam*, the *EOR* should be identified by the *owner*.

The *Qualified Professional Engineer* carrying out the *dam safety review* should consult with the *EOR* through interviews or participation in workshops.

REFERENCES

Ref.1: CDA. 2007. *Dam Safety Guidelines*.

Ref.2: CDA. *Bulletin: Application of Dam Safety Guidelines to Mining Dams 2013 .*

Ref.3: Environment Canada. 2009. *Environmental Code of Practice for Metal Mines.* Issued by the Mining Section, Environmental Stewardship Branch, document 1/MM/17.

Ref.4: *Mines Act*, RSBC. 1996 c. 293 (Updated to 2007).

Ref.5: BC MEM. 2008. *Health, Safety, and Reclamation Code for Mines in British Columbia*. British Columbia Ministry of Energy, Mines, and Petroleum Resources. And BC MEM 2016 Revised Part 10 of the *Health, Safety, and Reclamation Code for Mines in Biritish Columbia*

Ref.6: *Water Act*, RSBC.1996 c. 483.

Ref.7: BC Ministry of Environment, BC Ministry of Energy and Mines, and BC Ministry of Forest Lands and Natural Resource Operations. 2014. *Memorandum of Understanding – Regulation of Impoundments and Diversions on a Mine Site.* ~~http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/developing-a-mine/mou_impoundments_diversions.pdf~~

Ref.8: ICOLD (2012) International Commission on Large Dams: *Sustainable Design and Post-Closure Performance of Tailings Dams.* Preprint Bulletin 153. http://www.icold-cigb.org/GB/Publications/publications.asp

Ref.9: ICOLD (2011) International Commission on Large Dams: *Improving Tailings Dam Safety – Critical Aspects of Management, Design, Operation and Closure.* Bulletin 139. http://www.icold-cigb.org/GB/Publications/publications.asp

Ref.10: MAC (2011) Mining Association of Canada: *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities.* http://www.mining.ca/site/index.php/en/news-a-media/publications.html

Ref.11: MAC (2011) Mining Association of Canada: Second Edition. *A Guide to the Management of Tailings Facilities.* http://www.mining.ca/site/index.php/en/news-a-media/publications.html

Ref.12: MAC (2011) Mining Association of Canada: *Audit and Assessment of Tailings Facility Management.* http://www.mining.ca/site/index.php/en/news-a-media/publications.html

APPENDIX C: *DAM SAFETY REVIEW ASSURANCE STATEMENTS*

CD1 - *Dam Safety Review Assurance Statement* for *Dams* Regulated under the *Dam Safety Regulation*

CD2 - *Dam Safety Review Assurance Statement* for *Dams* Regulated under the *Mines Act*

APPENDIX C1: *DAM SAFETY REVIEW ASSURANCE STATEMENT* - WATER RESERVOIR *DAMS*

Note: This Statement is to be read and completed in conjunction with the current "*APEGBC Guidelines for Legislated Dam Safety Reviews in British Columbia, (*"*APEGBC* Guidelines"*)* and is to be provided for *dam safety review reports* for the purposes of the ~~*British Columbia*~~ *Dam Safety Regulation*, B.C. Reg. 40/2016 as amended. Italicized words are defined in the *APEGBC* Guidelines.

To: The *Owner(s)* Date: _____

_____
Name

_____

_____
Address

With reference to the *Dam Safety Regulation*, B.C. Reg. 40/2016 as amended.

For the *dam*:

UTM (Location): _____

Located at (Description): _____

Name of *dam* or description: _____

Provincial *dam* number: _____

Dam function: _____

Owned by: _____

(the "*Dam*")

Current *Dam classification* is:

Check one

- □ Low
- □ Significant
- □ High
- □ Very High
- □ Extreme

The undersigned hereby gives assurance that he/she is a *Qualified Professional Engineer.*

I have signed, sealed and dated the attached *dam safety review report* on the *Dam* in accordance with the *APEGBC* Guidelines. That report must be read in conjunction with this Statement. In preparing that report I have:

Check to the left of applicable items (see Guideline Section 3.2):

___1. Collected and reviewed available and relevant background information, documentation and data

___2. Understood the current *classification* for the *Dam*, including performance expectations

___3. Undertaken an initial facility review

___4. Reviewed and assessed the *Dam* safety management obligations and procedures

___5. Reviewed the condition of the *Dam*, reservoir and relevant upstream and downstream portions of the river

___6. Interviewed operations and maintenance personnel

___7. Reviewed available maintenance records, the Operations, Maintenance and Surveillance (OMS) Manual and the Dam Emergency Plan

___8. Confirmed proper functioning of flow control equipment

___9. After the above, reassess the consequence *classification*, including the identification of required *dam* safety criteria

___10. Carried out a *dam safety analysis* based on the *classification* in 9. above

___11. Evaluated facility performance

___12. Identified, characterized and determined the severity of deficiencies in the safe operation of the *Dam* and non-conformances in *dam* safety management system

___13. Recommended and prioritized actions to be taken in relation to deficiencies and non-conformances

___14. Prepared a *dam safety review report* for submittal to the *regulatory authority* by the *Owner* and reviewed the report with the *Owner*.

___15. The *dam safety review report* has been reviewed in meeting the intent of *APEGBC* Bylaw 14(b)(2).

Based on my *dam safety review*, the current *dam classification* is:

Check one

□ Appropriate
□ Should be reviewed and amended

I undertook the following type of *dam safety review*:

Check one

□ Audit
□ Comprehensive
□ Detailed design-based multi-disciplinary
□ Comprehensive, detailed design and performance

I hereby give my assurance that, based on the attached *dam safety review report,* at this point in time:

Check one

□ The *Dam* is reasonably safe in that the *dam safety review* did not reveal any unsafe or unacceptable conditions in relation to the design, construction, maintenance and operation of the *Dam* as set out in the attached *dam safety review report*

□ The *Dam* is reasonably safe but the *dam safety review* did reveal non-conformances with the *Dam Safety Regulations* as set out in section(s) ____ of the attached *dam safety review report.*

□ The *Dam* is reasonably safe but the *dam safety review* did reveal deficiencies and non-conformances as set out in section(s) ____ of the attached *dam safety review report.*

□ The *Dam* is not safe in that the *dam safety review* did reveal deficiencies and/or non-conformances which require urgent action as set out in section(s) ____ of the attached *dam safety review report.*

_____ _____
Name Date

_____
Signature

_____
Address

_____ (Affix Professional Seal here)

_____
Telephone

If the *Qualified Professional Engineer* is a member of a firm, complete the following:

I am a member of the firm _____
and I sign this letter on behalf of the firm. (Print name of firm)

APPENDIX C2: *DAM SAFETY REVIEW ASSURANCE STATEMENT* – MINING *DAMS*

Note: This Statement is to be read and completed in conjunction with the current "*APEGBC Guidelines for Legislated Dam Safety Reviews in British Columbia, ("APEGBC* Guidelines"*)* and is to be provided for *dam safety review reports* in accordance with permit conditions and the *Health, Safety and Reclamation Code for Mines in British Columbia* or the *Dam Safety Regulation*, B.C. Reg. 40/2016 as amended (refer to Table BC-1 in Appendix BC). Italicized words are defined in the *APEGBC* Guidelines. An assurance statement is required for each *dam* that is assessed.

To: The *Owner(s)* Date: _____

_____
Name

_____

_____
Address

With reference to the permit conditions and the *Health, Safety and Reclamation Code for Mines in British Columbia* or the *Dam Safety Regulation*, B.C. Reg. 40/2016 as amended (refer to Table BC-1 in Appendix ~~C~~B).

For the *Dam*:

UTM (Location): _____

Located at (Description): _____

Name of *dam* or description: _____

Provincial *dam* number: _____

Dam function: _____

Owned by: _____

(the "*Dam*")

Current *Dam classification* is:

Check one

- □ Low
- □ Significant
- □ High
- □ Very High
- □ Extreme

The undersigned hereby gives assurance that he/she is a *Qualified Professional Engineer*.

I have signed, sealed and dated the attached *dam safety review report* for the *Dam* in accordance with the *APEGBC Guidelines*. That report must be read in conjunction with this Statement. In preparing that report I have:

Check to the left of applicable items (see Guideline Section 3.2):

___1. Collected and reviewed available and relevant background information, documentation and data

___2. Reviewed the environmental objectives for the materials stored in the impoundment and related design requirements

___3. Understood the current *classification* for the *Dam*, including performance expectations

___4. Undertaken an initial facility review

___5. Reviewed and assessed the *Dam* safety management obligations and procedures

___6. Inspected the condition of the *Dam*, impoundment area and relevant areas upstream and downstream of the facility

___7. Interviewed operations and maintenance personnel

___8. Interviewed Engineer of Record

___9. Reviewed available maintenance and operating records, the Operations, Maintenance and Surveillance (OMS) Manual and the Dam Emergency Plan

___10. Confirmed proper functioning of mine waste and water management systems and environmental control systems

___11. After the above, reassessed the consequence *classification*, including the identification of required *dam* safety criteria

___12. Carried out a *dam safety analysis* based on the *classification* in Item 11

___13. Evaluated facility performance and conformance with design basis and operating criteria

___14. Identified, characterized and determined the magnitude of deficiencies in the safe operation of the *dam* and non-conformances in the *dam* safety management system

___15. Recommended and prioritized actions to be taken in relation to deficiencies and non-conformances

___16. Prepared a *dam safety review report* for submittal to the *regulatory authority* by the *Owner* and reviewed the report with the *Owner*

___17. The *dam safety review report* has been reviewed in meeting the intent of *APEGBC* Bylaw 14(b)(2).

Based on my *dam safety review*, the *dam classification* is:

Check one

□ Appropriate
□ Should be reviewed or amended

I undertook the following type of *dam safety review*:

Check one

□ Audit
□ Comprehensive
□ Detailed design-based multi-disciplinary
□ Comprehensive, detailed design and performance

I hereby give my assurance that, based on the attached *dam safety review report,* at this point in time:

Check one

□ The *dam* is reasonably safe in that the *dam safety review* did not reveal any unsafe or unacceptable conditions in relation to the design, construction, maintenance and operation of the *dam* as set out in the attached *dam safety review report.*

□ The *dam* is reasonably safe but the *dam safety review* did reveal non-conformances with the regulatory requirements as set out in section(s) ____ of the attached *dam safety review report.*

□ The *dam* is reasonably safe but the *dam safety review* did reveal deficiencies and non-conformances as set out in section(s) ____ of the attached *dam safety review report.*

□ The *dam* is not safe in that the *dam* safety review did reveal deficiencies and/or non-conformances which require urgent action as set out in section(s) ____ of the attached *dam safety review report.*

_____ _____
Name Date

_____
Signature

_____
Address

_____ (Affix Professional Seal here)

_____
Telephone

If the *qualified professional engineer* is a member of a firm, complete the following:

I am a member of the firm _____
and I sign this letter on behalf of the firm. (Print name of firm)

APPENDIX D: *DAM SAFETY REVIEW* BACKGROUND INFORMATION

A continuous set of design and service records provides a reliable basis for evaluations and decisions regarding possible unacceptable performance and potential *dam* safety improvements. This appendix is intended to provide a general outline of the type of background information that should be considered while recognizing that the specifics around background information including what is relevant will vary depending upon the nature of the *dam* undergoing a *dam safety review*. Careful judgment must be used for the analysis and interpretation of both primary and indirect sources of information and data. The *dam safety review report* should state the origin of the data used in the analysis and the assumptions that have been made.

- *Owner* and Organizational Information
  - *Owner's dam* safety policy/management system;
  - Organizational charts and responsibilities;
  - Applicable regulations (water license, permits, orders);
  - Purpose of structure (key capabilities and as-designed performance objectives);
  - Operational obligations (laws, regulations obligations and stakeholder *agreements*).
- Design and construction records
  - Design documentation;
    - Pre-design/Conceptual design reports
    - Location and physiography
    - Site Investigations
    - Field and laboratory testing
    - Geologic/hydrogeologic conditions
    - Hydrology
    - Water quality
    - Seismicity
    - Stability of structures
    - Design details (design sections, foundation prep, instrumentation, etc.)
    - Reservoir rim assessment
  - As-built drawings;
  - Construction and quality control;
  - Equipment specifications;
  - First reservoir filling data;
  - Original consequence *classification*.
  - Functional performance relative to key capabilities and as-designed performance objectives.

- Annual and routine *client dam* safety inspections
  - Annual or semi-annual inspection documents;
  - Special inspection documents;
  - Instrumentation records and documents;
  - Checklists (if not included in above);
  - Photographs and videos.
- Operation of discharge facilities
  - Operations, Surveillance and Maintenance Manual;
    - Operating parameters and procedures;
    - Inflow forecasting;
    - Summary of critical, maximum and other important water levels;
    - Emergency or unusual operations;
    - Flow control systems;
    - Testing and maintenance requirements;
    - Surveillance requirements;
    - Instrumentation;
    - Site communications;
    - Site safety and security.
  - Test records (annual, monthly, etc.);
  - Inspection records;
  - Operational records.
    - The OMS Manual should be reviewed as part of the *dam safety review*. It should provide pertinent information for the site review, staff interviews and discharge facilities testing. The OMS Manual is required under the *Dam Safety Regulation* and serves as a vital component of facility documentation. For mining *dams* the OMS Manual is required under the *Health, Safety and Reclamation Code for Mines in British Columbia*. It should, therefore, be critically reviewed in the office and in the field by the *Qualified Professional Engineer* and assessed as to whether the document is current (latest revisions, organizational charts, etc.), adequate, and understandable. As importantly, are the instructions in the OMS Manual being followed by operations and site staff (interviews).
    - The OMS Manual should state the *classification* and complexity of the *dam* and appurtenant facilities and clearly state the frequency and requirements of inspections, monitoring and testing. It should also include a surveillance plan which considers the *dam's* consequence, failure modes and performance indicators. The OMS Manual should include:
      - Description of facility, location, access (access restrictions) and *dam* history;
      - *Owner* description – Organizational relationship between *owner*, operator, *dam* safety and other departments, site staff organization and qualifications;

- Legal requirements – Government regulations, discharge requirements, downstream interests;
- As-built drawings and pertinent documentation;
- Key and critical levels and expected performance;
- Operating requirements – normal operations and operations during floods and adverse weather conditions, emergencies, discharge restrictions and reservoir evacuation, flood forecasting, ice and debris management;
- Maintenance requirements – inspections, testing and supporting documentation including operating and maintenance instructions, hydraulic and backup power information. Component requirements, such as, concrete structures, outlets, access routes;
- Surveillance Requirements – routine, periodic and enhanced surveillance plans together with inspection checklists, qualification of staff;
- Instrumentation – objectives, listings, drawings, calibration requirements, reservoir level redundancy, data management procedures;
- Site communications – modes, records, maintenance requirements;
- Emergency Preparedness (may be a separate document) – response, training, materials and equipment;
- Security and public safety.

- *Dam* Performance and Safety History:
  - Previous *dam safety reviews* or comprehensive inspection reports;
  - Updated inundation studies and mapping;
  - Dam Emergency Plan;
  - Deficiency Investigations;
  - *Dam* safety improvements, repairs or upgrades;
  - Updated drawings;
  - Updated information (hydrological, seismic, structural, geotechnical).
- Other *Owner* information (generally included in the OMS Manual):
  - Site location and access;
  - Access restrictions;
  - Training/safety aspect for site access (or specific areas);
  - Site staff qualifications;
  - Site staffing schedule.
- Other information and data sources that may be available to the *Qualified Professional Engineer* include:
  - Regional Dam Safety Officer or the Dam Safety section in Victoria, B.C., or the geotechnical engineering section of the British Columbia Ministry of Energy and Mines;
  - Large and small scale topographic and cadastral maps;

- Maps that show existing and proposed infrastructure, such as, transportation routes, utilities, residential and commercial subdivisions (information from local approving authority);
- Airphotos of different years (historical to present) and scales; high-resolution satellite imagery, and Light Detection and Ranging (LiDAR) images that can be also used for geological and geomorphological mapping and/or topographical mapping;
- Terrain maps, terrain stability maps, bedrock and surficial geology;
- Flood plain mapping and alluvial fan mapping;
- Previous development, including residential and non-residential, and associated infrastructure;
- Seismic data including: seismic hazard maps and reports; ground motion data, seismic site class, and modal magnitude values of the design earthquake.

- Potential updates to the original design criteria may include (see Section 3.4.4 changed conditions):
  - Inflow Design Flood (IDF);
  - Maximum Design Earthquake (MDE);
  - Water, ice, sediment;
  - Uplift and seepage;
  - Undetected adverse foundation conditions;
  - Construction defects;
  - Reservoir and Unexpected conditions;
  - Functional availability and reliability objectives;
  - Risk-informed performance expectations.
- Additional considerations, changed conditions or increased knowledge may include:
  - Alteration to discharge capacity – due to conversions of gates, settlement of embankment or changes in available free board. Obstructions such as debris, ice, landslides, debris flows or rockfall. Failure to operate due to power, control or overtopping of gates. Inconsistencies and incompatibilities in procedures;
  - Foundation/Abutment problems – Undetected geological defects, such as, open fissures, erodible or soluble materials, etc., have led to some notable *dam* failures including Teton Dam (1976) where core fines were transported in the foundation. Excessive settlements can occur due to hydrogeological changes in the foundation or natural ground may be poorer than considered in design. Potential liquefaction should also be considered;
  - Construction defects – Defects that result in conditions not considered in design include inferior materials and poor workmanship, particularly in older *dams*. Defective joints, inadequate foundation treatment and defective drains have resulted in excessive uplift. Construction interruptions (winter stoppages, etc.) can result in drying or freezing and creation of preferential seepage paths at different levels in the *dam*. Inadequate compaction at abutments, conduits, and other interfaces. Instrumentation problems associated with inadequate compaction or sealed lead trenches.

It is noted that International Commission on Large Dams recommends that the management of *dam* documentation include the preparation and updating at regular intervals of a "briefcase" containing all relevant information, such that it is easily transportable in digital form along with a hard copy of frequently used documents including:

- Synoptic description of the *dam* and its appurtenant works;
- Main drawings including layout, excavation, geology, ancillary works, foundation treatment, instrumentation, hydro-electromechanical equipment;
- Description and justification of design options, updated according to adaptations introduced during construction or operation;
- History of the *dam* since its first impoundment, with a chapter on any issue or item requiring special attention;
- End of construction reports, especially those related to quality control;
- Latest report on instrumentation data analysis and site reviews;
- Note on any eventual large repair works carried out or on hold;
- Maintenance instructions;
- A comprehensive list of references presented by topic (general studies, drawings, monitoring, equipment, etc.);
- Any expert reports;
- Photos and videos during construction and under operation;
- Reservoir bathymetry and hydraulic balance (to be updated each 2 years and after any major hydrological event);
- Executive summary of environmental impact and economical studies;
- Names and phone numbers of persons to be contacted for each specific event.

The "briefcase" should be placed under the specific responsibility of the *dam owner* and permanently updated particularly for monitoring data analysis, periodic reviews, repair or maintenance works and bathymetry. The most convenient way for gathering, retrieving and updating *dam* documentation may be achieved using a geographical information system. It needs, however, a significant effort to build, and is, therefore, only justified at present for very large *dams*.

> "*Ensuring the long-term integrity and continuous availability of data and important documents is a critical issue, considering threats associated with fire, power outages, software changes with time, and hardware changes with time. Important considerations include developing and maintaining reliable back-up systems, regularly updating software file systems, and preserving data and important documents in more than one form (paper copies, electronic files, including different types and methods of electronic files, etc.)*"…, *ICOLD B158.*

APPENDIX E: *DAM* SAFETY FIELD WORK

DAM REVIEWS

Visual review(s) focused on functional integrity, hazards, failure modes and failure mechanisms constitute an important and necessary component of the *dam safety review* field work by providing a qualitative observation-based analysis of the condition of the structure and its surroundings. Anomalies in the condition and behavior of the structure are most frequently identified by means of visual recognition of features or changes. In this regard, it is beneficial to carry out the *dam safety review* field review with surveillance staff who can comment on potentially important changes. The *dam safety review* field review should complement the routine inspections by *owner's* staff. The level of detail will depend on the complexity of the site, consequences of failure, past performance, and other parameters.

It is recommended that a checklist be prepared and utilized, based in part on the surveillance checklist provided in the OMS Manual, if this exists and adapted to the conditions and potential failure modes of the facility. The completed checklist, along with photographs and other information should be incorporated into the field review report and should describe all relevant site conditions, at the time of the field work. The format of the field review report will include adequate documentation of the inspection to facilitate review and follow-up; typically the field review report will be provided as an appendix to the *dam safety review report*. However, if significant *dam* safety concerns are identified at the time of the field review, the field review report can be used to facilitate early action.

Observations (notes, measurements, checklist entries, photos or video records) should be documented in a systematic and consistent manner. Review checklists should be comprehensive and include all components to be reviewed with prompts or notes for follow up. For reference, a generalized outline of a field review checklist developed by the province of BC (Dam Safety Section) can be downloaded from the Ministry's Water Management Branch website http://www.env.gov.bc.ca/wsd/public_safety/dam_safety/

The extent of a field review should be identified beforehand, but as a minimum include:

- upstream areas including reservoir slopes;
- abutment areas;
- upstream slopes or faces of the *dam*, where visible;
- *dam* crest;
- downstream slopes or faces, and toe areas;
- spillway and stilling basin (includes flow control equipment and power sources);
- drainage systems and discharge points;
- areas downstream of the *dam* site that may be impacted in a breach.

Annotated drawings are useful for record purposes and will facilitate follow up routine observations by site staff, such that these can then be carried out in a consistent manner, identifying any changed conditions. In addition, it is advisable to look at the same feature or anomaly from different perspectives or angles; this can reveal other important aspects that might otherwise go overlooked.

An understanding of the facility, its related potential structural and functional failure modes and the observed conditions (symptoms or maintenance issues) is an integral part of the *dam* field review. Besides observing functional performance and observing any visible anomalies, visual reviews should mainly focus on the identification of the following processes, their causes, and their consequences; most importantly changes that might be observed for different functions, components or areas of the facility:

- Seepage – Indicator of adverse conditions. Identification, monitoring and assessment of the quantity and clarity of seepage or change in seepage rate or turbidity, wet areas or change in vegetation pattern;
- Displacements and deformations – Indicators of *dam* stability. Rate of displacement;
- Cracking – Indicator of stability and impermeability. Extent, new or change in opening;
- Deterioration – Indicator of erosion, weathering and potential clogging of drainage measures.

(Further information is provided in ICOLD B154).

Changed conditions will be difficult to recognize for the *Qualified Professional Engineer* unless he/she is accompanied by the *dam owner's* staff who carry out the routine or annual inspections. Detailed questions related to the above issues and potential changes will assist.

TESTING OF DISCHARGE FACILITIES

The *dam safety review* field work will include review and, if possible, testing of all discharge facilities such as spillways and low level outlets. All equipment required for safe discharge of floods must be in place and well maintained such that it operates reliably. The field review should, in part, ascertain the capability and availability of the operators assigned to the *dam* to ensure that discharge facilities can be operated in a timely manner. The *dam safety review* should also consider their normal hours of operation, reaction time, potential rate of reservoir rise under large floods and access under all weather conditions which may be challenging in many areas of British Columbia. Operator training, operator authority and staff availability are some of the pertinent questions to be asked on site.

> *"Functioning of these outlets and of gated spillways depend primarily (but not only) on the performance of their moving parts, are generally essential for safe dam operation. It is vital for dam safety that these facilities can be operated – opened and closed – under all circumstances whenever needed. It is vital too that the gates remain as they are under all other circumstances. Malfunctioning can lead to disastrous accidents as evident from literature. To ensure that the facilities will operate reliably and safely, an appropriate program for checking and testing them is indispensable.*

Testing of gates and valves, together with review of valve chambers, accessible sections of low level outlets, outlet channels and energy dissipation should be carried out at a reservoir water level as high as possible. Review of those parts which are under water during normal operation can be carried out by divers with video equipment, when stoplogs are installed, or when/if the reservoir is emptied in the course of flushing out sediments; however, this information should be reviewed as part of the *dam safety review*.

The normal power supply as well as the emergency power system should be utilized for gate operation. If foreseen, manual operation should also be tested and reviewed onsite. If gates or valves can be operated from remote control centres, the tests should include checks of

communication between control centre and site. Weak points could be identified by analyzing the system and testing it as close to reality as possible. It is advisable to create separate checklists for these field reviews and tests. In general, the field reviews and tests should be carried out by the personnel familiar with the facilities and their history.

Reliable power supply is crucial to the safety of most *dams* as is access to the control equipment and emergency lighting.

Operations or mis-operation of discharge facilities including failure to discharge sufficient water, failure to maintain discharge gates is a hazard to *dam* safety. It is essential to have adequate operational rules fully documented in the OMS Manual that will result in safe passage of the design flood. Testing of gates periodically or after unusual conditions such as earthquakes to ensure jamming has not resulted is crucial as is power supply and remote control and monitoring, if appropriate. Questions directed to staff regarding this issue should be part of the field work.

Debris Management

Debris management is critical for many *dams* and reservoirs in British Columbia as debris blockage can significantly reduce the discharge capacity of the outlet facilities. Many areas in British Columbia are situated in heavily forested areas with steep topography and are subject to high winds and high levels of precipitation. Additionally, logging activities can result in a significant amount of debris entering the reservoir.

The containment of reservoir debris must be managed so that the safety of the *dam* is not impacted. *Dam safety review* field reviews should be cognizant of this hazard and include observations and questions to site staff regarding history of debris accumulation at the *dam*, frequency of debris removal, adequacy of containment booms, potential levels of debris accumulation along the shoreline and potential for sudden influxes of debris from slides or debris flows under high levels of precipitation. The potential impacts of both floating and submerged debris should be assessed.

Instrumentation

The *dam safety review* field work will include field review (discussions with staff) of the *dam* monitoring system, in order to develop an understanding of the instrumentation and monitoring system, if present. The *dam* monitoring system should provide for effective monitoring of the behavior of a *dam* and its foundation subjected to the applied loading conditions in order to detect any signs of abnormality and take action promptly. The analysis of the obtained data also gives an appreciation of the *dam's* behavior.

The main parameters that are usually monitored for embankment and concrete *dams*, including their foundations, encompass seepage (and turbidity), pore and uplift pressures, displacements and cracking. This provides for quantification of these parameters over time and confirmation against readings observed during the field work.

The management of data, including all procedures beginning with the data acquisition and ending in the data analysis, interpretation and reporting is included in the *dam safety review* under *dam safety analysis*. However, it is worth reviewing this information on site with staff familiar with the instrumentation and data trends, as data anomalies may be due to problematic installations which staff are familiar with. Data acquisition, validation, storage, and analysis are all important steps in data analysis. The adequacy of the monitoring system including data

acquisition, performance objectives, design and functionality, life expectancy and maintenance requirements should be addressed in the *dam safety review*. In order to provide prompt information, instrumentation must be monitored on a regular schedule, and the data must be reduced plotted and interpreted by qualified staff on a regular basis. A range of values indicating normal behavior should be established for all instrumentation and procedures for implementing appropriate actions in the event that instrumentation readings fall outside the normal range.

COMMUNICATIONS

Transmission of data and communication to and from the *dam* site is also important to safety of the *dam*, worker safety and vital communications should be tested as part of the *dam safety review* field work. If the lines of communication between site and control centre are redundant (landlines, cell, VHF), all modes should be tested. However, it should be noted that the availability of public networks may be insufficient in the case of extraordinary events and tests on a quiet sunny day may not be representative for emergency situations. Weak points in the system and potential for redundancy should be reviewed.

Communication between persons requires not only reliable communication lines but also updated telephone numbers available when and where they are needed. Safe communication also needs persons who are familiar with the situation and who know exactly what to do. Confirmation with site staff regarding this issue, should be part of the information obtained from the *dam safety review* field work.

STAFF INTERVIEWS

Generally staff interviews are held on-site and in conjunction with the field review work to provide the *Qualified Professional Engineer* with further information and insight into (i) operating and maintenance issues or incidents; (ii) staff conformance to procedures; (iii) operating authority under unusual conditions; (iv) equipment or system issues; (v) *dam* performance; (vi) the general level of training and knowledge of the staff; (vii) staff familiarity with the river system; (viii) the presence of other *dams* on the system, the nature of their operations, and any coordination or integration issues; (ix) any public safety issues; and (x) other stakeholders' interests.

Site staff should have an appropriate level of knowledge and familiarity with:

- OMS Manual
- Dam Emergency Plans
- Instrumentation & Monitoring Protocols
- Discharge facilities & Operations
- Responsibilities
- Training

APPENDIX F: SOCIETAL AND REGULATORY PRINCIPLES

The nature, form and focus of any analysis should be fit for the purpose for which the results will be interpreted and used. While required for regulatory purposes, the results of *dam safety reviews* have several purposes and are of interest to several quite different groups and entities including; the general public; any members of the public who would be impacted by operational activities at, or failure of, a *dam*; governments and *regulatory authorities*; emergency services and responders; *dam owners* and *dam* operators; *Qualified Professional Engineers* and *APEGBC*; the insurance industry; financing organizations; and non-governmental organizations including environmental groups and public interest groups. These "interest groups", while expected to have different objectives and alternatives can be broadly grouped into three categories (with sub-categories as appropriate):

- Societal
  - Laws and regulations (which frame societal expectations)
  - Professional engineering practice and licensing
  - Public protection and emergency management
- *Owner* and Business
  - Purpose and objects of *dam* (short, intermediate and long term)
  - Financing and insurance
  - Market and commercial factors
- Affected individuals, groups and non-governmental organizations

Dam safety analysis is set within the context of a *dam safety review* which is required by *Dam Safety Regulation*, but which cannot be completed without consideration of these contextual factors. Principles for *dam safety analysis* can be considered to reside within the corpus of principles that define these contextual factors and their relationships.

Against this background, the following "Hierarchy of Principles" provides a model for cascading downwards from the broadly based principles of a democratic society through the various constitutive societal arrangements that govern the purposes and the professional practice of *dam safety reviews* and *dam safety analysis*.

1. Societal and Regulatory Principles
   a. Statutory, Legal and Regulatory Principles
2. Engineering Principles
3. Business Principles
4. Principles of Engineering Practice
   a. Principles of *Dam* Safety Assessment, Reviews and Management
      i. Principles of *Dam Safety Analysis*

The basis for this hierarchical principles model is as follows:

> Societal and Regulatory Principles provide the overarching framework to achieve the objectives of government on behalf of its citizens. Safety regulation by government arises in this context with respect to striking a balance between market forces and protection. "*Safety regulation entails the regulation of risk to people, property, the environment and the wider social economy that arises from various human and industrial endeavours. It is the nature of risk that, frequently, those who create the risk do not bear its consequences nor its wider costs. So the market does not function properly as a distributive mechanism. The State must intervene to regulate risk. Regulation of risk is about making trade-offs. Trade-offs between different risks; between risks to some individuals or groups, and risks to others; between costs and benefits. In doing so, the state's regulator has to confront some basic issues: most notably, the need for economic, social and technological progress compared with "zero risk" or "guaranteed safety". The regulator has to assert the propositions that risk is a necessary part of the human condition; that progress often depends both on incurring risk and on learning from failures (that is, accidents); that risk must be controlled but cannot in most circumstances be eliminated; that control of risks must – in the interests of technological development and societal progress – move public opinion from focusing on what is acceptable to what is tolerable; and that 'safe enough' is the goal to be striven for in design, engineering and risk management."* (Bacon, J. 1999)

APPENDIX G: ELEMENTS OF *DAM SAFETY ANALYSIS*

The considerations which need to be addressed when carrying out a *dam safety analysis* so as to meet the intent of the 11 concepts provided in Section 3.5.4 are provided below.

These formal considerations are offered to support a *dam safety analysis* being carried out in a manner which meets the intent of addressing the hazards/threats to the safe functioning of a *dam* in an appropriate fashion.

- Hazards, include both external hazards and internal hazards due to the *dam* and its operation. External hazards include natural hazards, including mete*or*ological, seismic, and landslide and debris disturbances; and human agency (terrorism, vandalism etc.) that are "external" to the *dam* and the actions of which are outside the control of the *dam owner*. Internal hazards are within the control of the *owner* through the design, construction, maintenance and operational, and functional fault management of the *dam*.
- Failure modes; specifically the various ways that *dam* failure processes manifest themselves.
- Failure effects; (as opposed to failure consequences), refer to the end physical state of the *dam* during and after the operation of the failure mechanism.
- Consequences of functional failure of the *dam*.

Hazards:

Hazards can be considered to be external to the *dam* and reservoir system or internal to the system.

- External hazards (outside the control of the *dam owner*) hazards such as floods, earthquakes, reservoir environment hazards, and human agency.
- Internal hazards (within the control of the *dam owner*) hazards such as design errors; construction flaws, maintenance arrangements, operating procedures, etc.

The natural hazard environment of British Columbia is exceptionally challenging, and there are some significant differences between operating environments of *dams* across the Province.

<u>External hazard type</u>

- Meteorological events.
    - Floods, intense rain events (causing local erosion, landslides etc.), temperature extremes and the effects of ice, lightning strikes and wind storms.
- Seismic events.
    - Natural and those caused by economic activity such as mining or even reservoir induced seismicity. The fact that areas without active seismicity can be disturbed by distant earthquakes should not be ignored.
- Reservoir environment.
    - Includes all reservoir rim features including upstream *dams*, slopes around the reservoir, overhead off spillways etc. that pose a threat.

- Reservoir environment also includes any deleterious substances, or burrowing or other animals, that can affect the physical performance of the *dam*.

- Terrorist attacks and vandalism.
  - Including vandalism and sabotage by various groups ranging from local disaffected individuals, through domestic terrorism and international terrorism.

Internal hazard type

- Errors and omissions in the design of the *dam* and water conveyance structures including inadequate consideration of the performance of the reservoir rim and upstream *dams*.
- Construction errors or design compromises to accommodate natural or imposed deviations from the design assumptions.
- Maintenance procedure errors where maintenance requirements are not fully defined at the design stage.
- Errors and omissions in the development and maintenance of operating rules or means of verifying adequate operation (e.g. infrastructure problems with water level recorders).

The internal hazard types are further subdivided into "sources":

Internal hazard type sources

- Water barrier: All elements retaining or interfacing with the body of water including the main *dam*, any concrete spillway structure with water retaining functions, saddle *dams*, etc.
  - Spillway gates that function as water retaining subsystems form part of the water barrier.
- Hydraulic structures: All water conveyance structures required to direct water around or through the *dam* in a controlled way.
  - Typically, spillway structure, low level outlet structure and power water passages (canals and penstocks etc.)
- Mechanical and Electrical sub-systems: All mechanical and electrical equipment and machinery required to control the reservoir level.
  - This will typically include all mechanical and electrical subsystems and controls at the *dam* site and, in the case of remotely controlled *dams*, the remote control centre. The definition of the system boundary will include the boundary around the control systems.
- Infrastructure and Plans: The term "infrastructure" may be used to describe all physical infrastructure and equipment necessary for the collection of data and information required to verify the performance adequacy of the *dam*. The term "plans" is used to describe all of the "non-physical" *dam* safety activities necessary to support *dam* safety, including the design, construction maintenance and implementation of all operating and safety procedures that form part of the engineering design of the *dam* and safety system.
  - The "infrastructure" will include all instruments and its physical supports. It will also include access roads, audits, portals, etc. required for siting and reading the instruments.
  - The "plans" will include all of the engineering design of all operating orders, maintenance strategies and plans, surveillance procedures and the emergency plans, all of which form part of the engineering design. "Plans" also includes all forecasts such as inflow forecasting.

- In general, if some form of additional infrastructure or a plan (especially if human activity is involved) is required to ensure adequate performance of the water barrier, the hydraulic structures or the mechanical/electrical system with respect to any failure mode or functional failure characteristic, then infrastructure/plans will form a hazard/failure mode pair.

Failure Modes

A failure mode describes how element or component failures must occur to cause loss of the sub-system or system function; specifically the containment and conveyance functions. In this regard, failure modes are not unique features of the *dam* but artefacts of how the functions of the *dam* are determined in design and represented and modelled in the *dam safety analysis*.

Two general containment failure mode categories can be described for *dams* and while these categories are often too general for definitive analysis of the safety of a *dam*, they provide a basis for structuring the analysis and for explaining the results of the analysis. At a very general level, there are two containment failure modes, *dam* overtopping and *dam* collapse.

Overtopping failure mode

- Inadequate freeboard leading to the flow of water over the crest of the *dam* in a manner not intended or provided for in the design, construction, maintenance and operation of the *dam*.

Collapse failure mode

- Inadequate internal resistance to the hydraulic forces applied to the *dam*, foundations and abutments while being hydraulically operated in accordance with the design intent.

Typically, conveyance failure modes are numerous, more obscure and less well defined than the containment failure modes of a *dam*, and typically involve the materialisation of internal hazards including management and procedural hazards.

Conveyance failure mode

- Loss of control of the flows through and around the *dam*

Combinations of Hazards and Failure Modes

It is now recognized that *dam safety analysis* that considers natural hazards such as floods and earthquakes separately is non-conservative from a safety perspective. This is particularly the case if the sole focus of the *dam safety analysis* is restricted to the traditional consideration of only the Probable Maximum Flood and/or the Maximum Credible (Maximum Design) Earthquake taken in isolation.

The results of the hazards and failure modes identification process may be represented in various ways. One such way is to graphically represent all of the safety management measures in place at a *dam* in graphical form such as in a "fault tree" diagram[2], or in the form of the fault tree representation such as Hazards and Failure Modes matrix form presented on the BC Government Dam Safety web-site.

Consequences of functional failure of a *dam*

The *Dam Safety Regulation* includes a 5-tier *dam* failure consequence *classification* scheme for *dams* which aligns the consequence *classification* of British Columbia *dams* with the *CDA Dam*

[2] ICOLD, B154 (2012)

Safety Guidelines thus ensuring British Columbia's *dam* safety requirements are consistent with the *CDA Dam Safety Guidelines*.

The consequences of functional failure of a *dam* will typically be different for the containment and conveyance functions. Since the functions are not independent of each other, loss of the conveyance function may result in loss of the containment function with the same ultimate loss.

Dam failure consequence analysis involves developing a model of the reservoir, its operations and the region downstream of the *dam* and then analyzing the effects of deviations in the water conveyance functions of the reservoir operations model.

The complexity of the model and the extent of the modelling endeavour will vary from one situation to the next depending on the extent of the *dam* breach inundation, and the demographics and land use of the area affected by the flood. The system boundary may be limited to the extent of the inundation or it might be larger if wider environmental, social and economic issues are considered.

As is the case with analysis of functional failure, the level of the modelling effort will also depend on the degree of resolution required by the *dam safety analysis* as determined at the outset of the *dam safety review*. In keeping with the iterative nature of the *dam safety analysis* process, it is generally appropriate to begin with a relatively coarse representation of the downstream area, moving to more refined modelling techniques as the need arises.

Typically, functional failure consequences of interest will include:

- Threats to public safety
- Environmental degradation
- Infrastructure and property damage and losses
- Socio-economic impacts, including political and public perception issues,
- *Owner's* reputation and financial integrity.

Because of the broad range of considerations involved, consequence analysis is a multidisciplinary endeavour, which has many analytical components that are outside the realm of engineering. Typically, the engineering analysis pertains to modelling:

- Reservoir operation;
- Formation of the breach in the *dam;*
- Characteristics of the *dam* breach flooding; and,
- Damage state and magnitude of the loss in the affected areas downstream.

From an analysis perspective, *dam* breach consequences can be broadly considered to fit into two main categories:

- Direct consequences attributable to contact with the flood waters; and,
- Indirect consequences that arise as a result of the direct consequences.

Typically, direct consequences, which are the focus of this chapter, are divided into three categories:

- Life safety;

- Economic and financial; and,
- Environmental impact.

The following boundaries apply to this categorization (model):

- Public safety including life safety considerations that apply to loss of life, physical injuries and emotional trauma caused by direct contact with flood waters.
- Economic losses pertain to all third party economic impacts whereas financial losses pertain solely to the *dam owner*.
- Environmental degradation refers to environmental losses that occur during the flood event, with collateral losses of habitat that impact migratory species being considered as indirect losses.

Typically the physical entities and objects considered include:

- People, buildings
- Structures and infrastructure
- Animals, fish and wild life species
- Habitat objects such as trees, landscapes etc.

The analysis should state the considerations involved in considering the dynamics of releases from *dams* and reservoirs and flows and the interaction with affected entities and objects. Specific details with respect to the interactions between people and flows should be provided.

Consideration of Functional integrity of a *Dam* as Part of a System

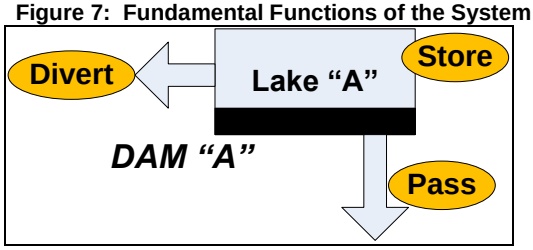
In recent years, it has become clear that it is necessary to consider the contributions that operational disturbances present as a hazard to a *dam* that should be taken into account in a *dam safety review*. Essentially the *dam*/reservoir/production unit system transforms inflows into the reservoir from rainfall and runoff that are often considered as being random natural processes, into controlled outflows, while delivering goods and services that are of benefit to society.

The *dam safety review* draws conclusions as to the structural performance of the *dam* to withstand the forces that are applied to it and the resilience of the *dam* to maintain the structural support and integrity required for the functions of the *dam* and reservoir. The functional performance and resilience pertain to the various processes, products and services that the *dam* is intended to provide. Specifically, the *dam* is intended to retain the stored volume and to pass all flows through and around the *dam* in a controlled manner. In simple terms, the *dam* has containment and conveyance functions in support of one or more hydraulic processes. The conveyance functions can be further subdivided into diversion flows for productive purposes such as power production or irrigation, and release flows where by the water is passed directly from upstream to downstream for safety, environmental or social purposes. The range of the volumes of water to be stored as divided into “live storage” and “dead storage”, the rate of change of storage, the rate at which water is diverted and the rate at which water is passed directly downstream are all interrelated and must be considered throughout the *dam safety analysis* process.

The *dam*, when considered in these general terms performs up to three fundamental functions; water storage (Store) for future use, water passage (Pass) to fulfill immediate downstream

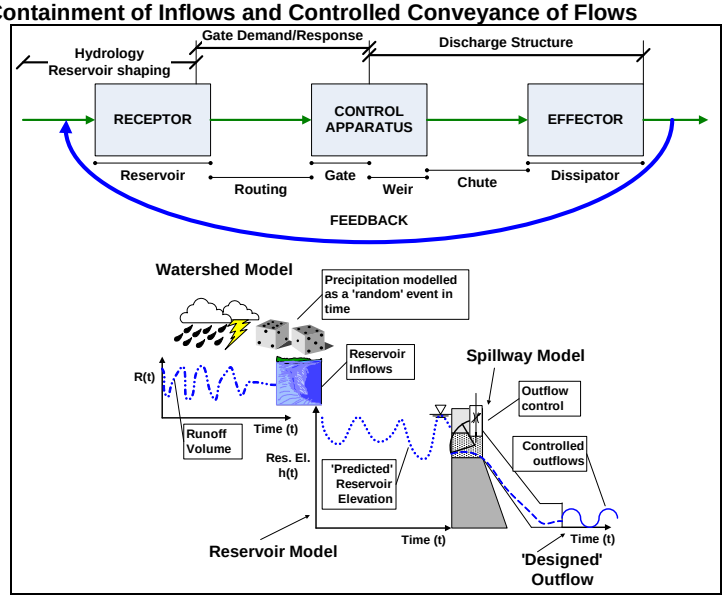
demands including the vitally important safety function, and, water diversion (Divert) for alternative productive purposes (Figure 7).

Figure 7: Fundamental Functions of the System



The engineering of *dams* and reservoirs involves designing a system to transform essentially random inflows into controlled outflows passed either by means of diversion of flows for production purposes or for passage around the *dam* to satisfy downstream production needs. In schematic terms this process can be illustrated as in Figure 8. Analysis of the performance of these functions is central to the *dam safety analysis*.

Figure 8: Containment of Inflows and Controlled Conveyance of Flows



Consideration of Uncertainty

Uncertainty pervades all aspects of *dam safety analysis*, and the *Qualified Professional Engineer* should include a statement in the practice analysis of the uncertainties that are identified in the *dam safety review*. The uncertainties are of two kinds; inherent randomness otherwise known as aleatory uncertainty; and knowledge or epistemic uncertainty. The *dam safety review* would be expected to identify the relative contributions of these two types of uncertainty to the total uncertainty, and to identify opportunities to reduce the total uncertainty by means of scientific advances or investigations to eliminate gaps in knowledge.

One implication of the effects of uncertainty is that a *dam* might be determined not to be reasonably safe because of the prevalence of knowledge (epistemic) uncertainty that can be reduced by means of accepted methods such as monitoring or surveillance. However, the nature of uncertainty is such that the *Qualified Professional Engineer* might deem a *dam* to be reasonably safe with the condition that certain uncertainties are reduced within a reasonable period of time. Such consideration is required to avoid declaring a *dam* that is actually reasonably safe to not being reasonably safe simply because sufficient corroborating evidence is not available.

A comprehensive treatment of uncertainty in *dam safety analysis* is provided in the authoritative text book *Risk and Uncertainty in Dam Safety* (2004).

APPENDIX H: NATURAL HAZARD CONSIDERATIONS IN *DAM SAFETY REVIEWS*

INTRODUCTION

Natural hazards, external to the *dam* itself, impose the most significant loadings on the *dam* structure and associated facilities. This introductory section will define these natural hazards and suggest how they should be included into a *dam safety review* both individually or in combination.

HYDROLOGICAL LOADINGS

The principal loadings on a *dam* are hydrological and can be defined by performance criteria; the ability of the *dam* to retain the reservoir and the ability of the flow control equipment at the *dam* to pass the river flow. The external natural hazards associated with the hydrological loadings on the *dam* are the river flows and floods resulting from precipitation, snow melt and run-off in the catchment area, ice loadings and siltation.

The *Qualified Professional Engineer* should verify the currency and adequacy of the hydrological loading, commensurate with the complexity of the *dam* system and the *classification* of the *dam*. The Technical Bulletin*, Hydraulic Considerations for Dam Safety* which are associated with the 2007 *CDA Dam Safety Guidelines*, provides a summary of the state of practice in Canada and the *Qualified Professional Engineer* should give considerations to these guidelines for the evaluation of the hydrological loading on the *dam*.

The estimation of extreme events, such as flood, is often derived from statistical analyses of historic recorded data. These estimations do not take the possibility of climate change into account. Climate change may increase the frequency of high river flows and may increase the magnitude of extreme floods. Climate change is generally considered to be the change in weather patterns in the future, predicting changes over the next 50 to 100 years. However, the *dam safety review* considers the safety status of the *dam* at the present time. Therefore the *dam safety review* does not need to take into account estimates of how climate change may affect the frequency of high river flows and the magnitude of extreme floods. The potential impact of siltation should be assessed.

SEISMIC LOADINGS

British Columbia is situated adjacent to a destructive tectonic plate margin and has experienced significant earthquakes in the past. The seismic hazard varies considerably across the province. In the regions of high seismicity, the seismic hazard may be the governing loading condition of the structure and foundation of the *dam*. Failure of a *dam* caused by seismic ground motion may be sudden and catastrophic and therefore the determination of the seismic hazard for the *dam* is often critical in the assessment of the safety of the *dam*.

The seismic hazard parameters and uniform hazard spectra generated for the *National Building Code* of Canada represents the median hazard values and are not site-specific. This data has been developed mainly for major urban areas and as a result may be conservative for remote sites. As the mean hazard values are recommended for use in typical seismic hazard computations for *dam* safety engineering, the seismic hazard parameters derived from the *National Building Code* should not be used for *dam safety review*s. However, the use of seismic hazard parameters derived from the *National Building Code* could be used for a screening level

analysis provided appropriate correction factors are applied and that the limitations of the use of these approximate parameters are recognized.

The *Qualified Professional Engineer* should verify the currency and adequacy of the seismic loading, commensurate with the complexity of the *dam* system and the *classification* of the *dam*. The Technical Bulletin, *Seismic Considerations for Dam Safety* which are associated with the 2007 *CDA Dam Safety Guidelines*, provides a summary of the state of practice in Canada and the *Qualified Professional Engineer* should give considerations to these guidelines for the evaluation of the seismic loading on the *dam*.

LANDSLIDE LOADINGS

Throughout the world, there is a significant history of catastrophic landslides into reservoirs and natural lakes. In Vaiont Italy (1963), more than 2000 people were killed and many injured when a landslide of some 270 million m^3 generated a wave 125 m over the *dam*, causing destruction for 10 miles downstream. Other examples include Loen, Norway with loss of life of 61 people and Chungar, Peru with an estimated loss of life of 400 to 600 people. A recent British Columbia example that highlights the complexity of all areas in the vicinity of the reservoir and *dam* is the June 13, 2010 debris flow initiated on Testalinden Creek, by overflow failure of a small earth *dam*. The event involved an estimated volume of 240,000 to 260,000 m^3 of material, impacted an area of about 23.6 ha, and resulted in extensive property damage[3].

Reservoir rim hazards include overtopping waves, direct impacts and significant indirect impacts to the *dam* and appurtenant structures may cause failure or severe damage to the *dam* itself as well as upstream and downstream areas. If these natural hazards exist, the *Qualified Professional Engineer* must evaluate these hazards to the same degree as floods and earthquakes and under all anticipated loading conditions (seismic, high infiltration, rapid drawdown, and load combinations) to see if induced waves and/or other effects pose an unacceptable risk to the public, *dam* or its appurtenant structures.

The terrain adjacent to reservoirs, particularly in mountainous regions of British Columbia, can be very steep and susceptible to large landslides, avalanches, rockfalls and debris flows. In addition, in seismically active areas such as British Columbia, earthquakes can destabilize slopes leading to landslides, liquefaction and major slope displacements. Slope movements or other instabilities such as glacier collapse or major rockfalls are frequent phenomena which can occur with or without the presence of a *dam*/reservoir. The phenomena may become more frequent as a result of shoreline erosion and hydrogeological changes, due to the presence of a reservoir. Additionally, upstream *dams*, natural barriers, debris and ice may also present significant hazards. The critical areas of the reservoir circumference require careful observation to identify these hazards and slopes which could become unstable in time. Reservoir ice and debris can also create hazardous situations depending on the amount, thickness of these materials on the reservoir and characteristics of the facility[4]. Ice or debris jamming, blockage and impact loading in spillways and on gates are hazards the *Qualified Professional Engineer* should be aware of and account for.

3 *EBA 2010/11*
4 *CDA07, Hydrotechnical Considerations*

The process of investigation and managing slope instability issues is a logical sequence of technical evaluation and risk management including[5]:

- Identifying actual and potential slope instabilities or other potential hazards (through airphoto analysis, mapping, and other field techniques);
- Carrying out field investigations;
- Establishing geologic, hydrogeologic and geotechnical database;
- Developing and reviewing conceptual slope models;
- Assessing stability (potential, mode, post failure conditions);
- Determining hydraulic effects;
- Assessing potential consequences.

Most *dam safety reviews* are carried out during the operational phase of the facility and practical steps that will minimize or mitigate the risks of reservoir hazards may be limited, but do include:

- Ensure management recognition of the potential consequences of these hazards and the risks they impose; ensure sufficient effort has gone into the identification/ evaluation process;
- Maintain and continue engineering assessments of identified hazards and issues;
- Review slope models after any unusual loadings (high precipitation, earthquake or rapid drawdown);
- Establish an on-going monitoring, performance reviews and *dam safety review* program.

PARTIAL LISTING OF AVAILABLE REFERENCES - LANDSLIDE GENERATED WAVES

Guidelines

- International Commission on Large Dams (ICOLD) 2002. Reservoir Landslides: Investigation and Management, Guidelines and Case Histories. Bulletin 124.
- *APEGBC*, 2010. Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC, Association of Professional Engineers and Geoscientists of British Columbia, 75p.
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5 *ICOLD B124* (2000)

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APPENDIX I: AUTHORS AND REVIEWERS

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EDITORIAL AND LEGAL REVIEW

Robert W. Hunter, LLB, Bull Housser

MEMORANDUM OF AGREEMENT

BETWEEN

THE ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEOSCIENTISTS OF THE PROVINCE OF BRITISH COLUMBIA

AND

THE IRANIAN ENGINEERS OF BRITISH COLUMBIA ASSOCIATION

WHEREAS

The Association of Professional Engineers and Geoscientists of the Province of British Columbia (APEGBC) and the Iranian Engineers of British Columbia Association (IEBCA) have common goals regarding:

- the establishment and expansion of relationships with professional communities;
- the facilitation and promotion of professional development and networking opportunities for their members, including immigrants, new comers as well as Canadian citizens;
- the promotion of the skills, knowledge and talent of their mutual members;
- the provision of information and guidance to internationally trained engineers to promote their integration into the profession of engineering in British Columbia.

THEREFORE

APEGBC's Council has agreed to permit the use of the words 'engineer' and 'association' in the IEBCA's name, on the following conditions:

IEBCA will:

A. ensure that its members trained in engineering:
   1. are registered with APEG BC (PEng, EIT, Provisional Member);
   2. have Qualifications assessed and approved by the CCPE Initial Assessment or EIEAP program; or
   3. possess a bachelor's degree or higher in an engineering discipline and have a minimum of four years of experience.

B. ensure that its members trained in engineering have signed an undertaking acknowledging that:
   1. they understand and agree to abide by the Prohibition on Practice, and all other provisions in the Engineers and Geoscientists Act; and

2. if they are not a member of APEGBC, they will apply for membership with APEGBC as soon as they are employed in a supervised engineering capacity.

C. provide, in a prominent place on its website, appropriate disclaimers and explanations as to its role versus that of APEGBC, with Prohibition on Practice information displayed, and appropriate links to APEGBC's website;

D. recognize the legislated mandate of APEGBC; and will not represent itself, nor permit its members to represent it in any way that can lead the public to assume that all of IEBCA's members are Professional Engineers or members of APEGBC, or that IEBCA is in any way responsible for the qualification, certification or regulation of engineers in British Columbia; and

E. in order to reduce potential confusion of the two organisations' names and roles, restrict the use of its full legal name to those situations where it is required by law and will otherwise refer to itself as the Iranian Engineers of BC or IEBCA.

IEBCA and APEGBC to their best intention and abilities to accomplish the afore-mentioned goals also establish their mutual efforts as follows:

1. IEBCA and APEGBC become "Supporting Partners" for the duration of this MoA. The partnership will emphasize and make endeavours for mutual areas of collaboration on a case by case and pre-approval basis that are in line with the two organizations' goals and members benefit.

2. IEBCA and APEGBC will organize mutually related events and/or promote selective events to their members list or publish on their websites. This promotion will be for selective events that are communicated in advance and receive the organization authorized representative's approval.

3. As IEBCA regularly holds technical engineering and personal skills events to enhance their members' knowledge and skills on engineering profession and career development, APEGBC recognizes the IEBCA events as eligible CPD (continuing professional development) hours. A member's declaration of IEBCA event CPD hours shall meet the APEGBC CPD guidelines, compliance and categories. This ensures that members maintain a high standard of professional practice and support the APEGBC mandate of protecting the public interest. IEBCA will use its best endeavour to maintain their events quality to the acceptable level of APEGBC standard.

4. The associations may consider to become "annual" and/or "event" sponsor on a case by case basis per the organization authorized representative's approval.

This Memorandum of Agreement represents a commitment by APEGBC and IEBCA to work in good faith to support each other's goals and mandates.
This Memorandum of Agreement will be reviewed every three years by APEGBC and IEBCA and may be terminated by either party at any time.

SIGNED this _____day of _____, 2016

on behalf of APEGBC by:

_____
Robert Stewart, P.Eng., FEC
President, APEGBC

on behalf of IEBCA by:

_____
Homayoun Khatami, P.Eng., CEM, PMP, CMC
President, IEBCA

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SIGNED this _____day of _____, 2016

on behalf of APEGBC by:

_____
Robert Stewart, P.Eng., FEC
President, APEGBC

on behalf of IEBCA by:

_____
Homayoun Khatami, P.Eng., CEM, PMP, CMC
President, IEBCA

Comments from APEGBC Staff on the Expert Panel Terms of Reference Regarding the Modernization of the NEB and Review of Environmental Assessment Processes

Disclaimer: Due to the very short timeline given for comments (30 days), the comments contained herein have not been considered by APEGBC Council. Therefore, these comments are not necessarily the official positions of APEGBC Council.

Background

The Association of Professionals Engineers and Geoscientists of BC is the regulatory body established under the *Engineers and Geoscientists Act* for engineers and geoscientists in the Province. The Association has the mandate to establish, enforce and maintain standards of practice for its over 24,000 professionals.

As part of its regulatory function, APEGBC works with the municipal, provincial and federal levels of government to enhance public protection and provide leadership in addressing issues relating to the practice of professional engineering and geoscience. Recognizing that legislation and regulations from federal, provincial and municipal jurisdictions overlap in a complex manner, APEGBC takes an active role in commenting on legislation, regulations and guidelines from these jurisdictions that impact the practice of its professionals. Recent efforts include:

1. APEGBC's feedback on Environment and Climate Change Canada's (ECCC) proposed methodology for estimating the upstream greenhouse gas (GHG) emissions associated with major oil and gas projects undergoing federal environmental assessments
2. APEGBC's feedback on Engineers Canada's draft National Guideline on Sustainable Development and Environmental Stewardship for Professional Engineers
3. APEGBC's review of the draft 2016-19 Federal Sustainable Development Strategy, which outlines how federal government departments and agencies are working to create a sustainable economy and protect the environment

This response has been prepared with input from APEGBC's Climate Change Advisory Group, Sustainability Committee and the Division of Environmental Professionals, which includes professionals who are directly or indirectly involved in the environmental assessment processes and whose professional practice could be influenced by the changes to the National Energy Board and Environmental Assessment Processes.

Position on Climate Change

The Association has established several ground-breaking professional practice documents and position papers related to sustainability and climate change, which lay out commitments that the Association makes to the public, as well as the Association's expectations of how its members conduct their practice. These include a position paper entitled "A Changing Climate in British Columbia: Evolving responsibilities for APEGBC and APEGBC Registrants"[1], adopted in 2014, and a second position paper, just adopted by Council and shortly to be published, entitled "APEGBC's Position on Human-Induced Climate Change", which states that APEGBC members have the potential to influence greenhouse gas emissions through their professional activities, and are expected to consider the impact of their work on the climate.

The Association has an evolving portfolio of practice guidelines on the topic of climate change adaptation and mitigation to support its members, including:

- Legislated Flood Hazard Assessments in a Changing Climate in BC
- Professional Practice Guidelines – Developing Climate Change Resilient Designs in the Design of Highway Infrastructure in BC (in development)
- Building Energy Modelling Guidelines (in development)

APEGBC's professionals work closely with the Provincial government to provide expert advice on environmental and energy-related matters or the impacts of climate change on the professional practice of its members. Examples include: the development of a "Stretch Code" for buildings, an aspirational code that sets performance targets for buildings above the BC Building Code, to enable the development of ultra-low emission buildings in the Province, assisting in the

[1] APEGBC, 2014. "A Changing Climate in British Columbia: Evolving responsibilities for APEGBC and APEGBC Registrants". Available at: https://www.apeg.bc.ca/About-Us/Commitment-to-Community/Climate-Change

development of municipal climate resilience plans, actively participating in the consultation process in the development of the Provincial Climate Leadership Plan and the development of professional practice guidelines to ensure climate change resilience is considered and incorporated in engineering design. *BC Ministry of Transportation and Infrastructure's* Technical Circular entitled "Climate Change and Extreme Weather Event Preparedness and Resilience in Engineering Infrastructure Design" which kick-started the climate resilience efforts in the Province can be found here: http://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/engineering-standards-and-guidelines/technical-circulars/2015/t06-15.pdf.

Comments

The Climate Change Advisory Group, the Division of Environmental Professionals and the Sustainability Committee offer the following comments on the draft Terms of Reference to create an Expert Panel for modernization of the NEB and review of the Environmental Assessment processes:

Comments on National Energy Board modernization: Draft Terms of Reference for Expert Panel

- The draft Terms of Reference indicates that "…Panel members should have sufficient expertise in fields such as environmental science, community development, and Indigenous traditional knowledge", which is laudable. However, we would also seek a commitment that the panelists should also have expertise in the areas of energy policy, climate policy, and a sound understanding of the science of climate change. It is recommended that the panel be comprised of, and/or seek input from, the professional engineering and geoscience associations, climate scientists and leaders in the fields of energy policy, greenhouse gas mitigation policy and climate adaptation;
- Size of the panel and the expertise and background of the Panel members must be established in the Terms of Reference;
- If significant changes are proposed to the Panel's TORs, the TORs should be provided to the public again to seek comments on the changes made;
- The Panel's mandate, as it relates to the issue of climate change, should be clarified in the Terms of Reference so that the public and other stakeholders are able to provide input, cognizant of Federal climate action goals;
- The Scope of Review by the expert panel on NEB modernization includes the potential to expand the mandate to cover renewable energy. As this has not been part of NEB's mandate in the past, significant time must be spent by the panelists to establish how the transition to a low carbon economy can be realized through the NEB modernization process;
- Clarity is required in the NEB's mandate, with respect to energy data collection, dissemination, information and analysis.

Comments on Environmental Assessment Processes: Draft Terms of Reference for Expert Panel

- To address the current perception that compliance with existing regulations is inadequate, the Environmental Assessment Processes must include discussions on how to address the issue of compliance/enforcement and how to adequately resource enforcement. This would bolster public confidence in the value of existing and updated regulations;
- There are many legacy, non-operating resource extraction sites in British Columbia (and throughout Canada), which appear not to have been sufficiently remediated/restored and/or have assets that have not been adequately decommissioned. The Environmental Assessment Processes must include discussions on how to ensure that decommissioning, remediation and restoration is consistently completed at a level to regain public trust.
- It is imperative that the Environmental Assessment Processes account for the cumulative environmental effects, both geographically and temporally, which result from the designated project. This accounting must include consideration of not only the impacts for the project but the impacts that the development of the project may also precipitate through further contemporary projects or related legacy projects.

- The Government of Canada has commitment to provide national leadership on climate action and join with the provinces and territories to establish a price on carbon and cut carbon emissions in accordance with Canada commitment under the Paris Agreement. To achieve this, to the extent realistically possible, the downstream greenhouse emissions must be considered in the environmental processes, whether they occur in Canada or outside the country.
- Climate change is impacting existing infrastructure and will, with doubt, impact future projects. Keeping in mind the precautionary principle, the review of Environmental Assessment Processes must discuss how to incorporate consideration of the climate change impacts *of* projects and the climate change risk *on* projects; in other words, it must include provisions for both mitigation of greenhouse gas emissions and adaptation to the impacts of climate change.
- The Environmental Assessment Processes should include an assessment of alternative scenarios, i.e., project alternatives that might still meet the project proponent's needs, but at lower environmental impact.
- The Environmental Assessment Processes must establish the need for ongoing monitoring of the environmental impacts of the project, to ensure they are with expected bounds, and to take remedial action should the impacts exceed those agreed upon when the project was approved.
- The Environmental Assessment Processes must also consider the human health impacts of projects. Currently the impact of projects on human health are overlooked, and in a changing climate human health and the environment cannot be separated, the role of Human Health Impact Assessment must be integral to the Environmental Assessment Processes.

The Association thanks the Federal government for the opportunity to comment on the draft terms of reference for these two Expert Panels, and joins Engineers Canada in requesting that members from professionals associations with appropriate expertise be part of these Panels. For further information or any questions with regards to this submission please contact:

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Professional Engineers and Geoscientists of BC

Canada's Environmental Assessment Process

Presentation to the Expert Panel
Vancouver, December 12, 2016

Professional Engineers and Geoscientists of BC

About APEGBC

- Regulatory body established under the *Engineers and Geoscientists Act*.
- Has the mandate to establish, maintain and enforce standards of practice for its over 24,000 practising engineers, geoscientists, and licensees.

APEGBC's Interest

- This response has been prepared with input from:
  - APEGBC's Climate Change Advisory Group,
  - Sustainability Committee and
  - the Division of Environmental Professionals,

  who are directly or indirectly involved in the environmental assessments and whose professional practice could be influenced by the changes to the Environmental Assessment Process.

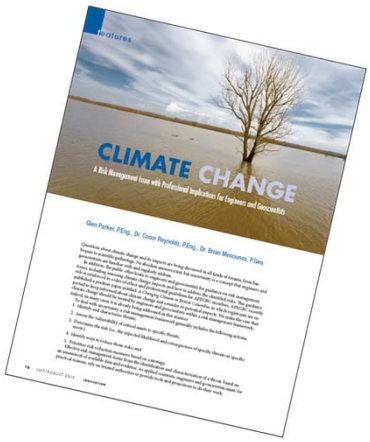
Position on Climate Change

- APEGBC commits to raising awareness about the changing climate and to provide members with information for managing the implications on their professional practices.
- APEGBC accepts that there is strong evidence that human activities, in particular activities that emit greenhouse gases, are contributing to global climate change.
- APEGBC Registrants have the potential to influence greenhouse gas emissions through their professional activities and are expected to consider the impact of their work on the climate.

Professional Engineers and Geoscientists of BC

APEGBC's Climate Action

- Professional Practice Guidelines on adaptation and mitigation:
  - Legislated Flood Hazard Assessments in a Changing Climate in BC
  - Climate Change Resilient Designs in the Design of Highway Infrastructure in BC
  - Building Energy Modelling Guidelines (in progress)
- Climate Change Information Portal
- *Innovation* articles
- Continuing Professional Development Events



Professional Engineers and Geoscientists of BC

Climate Change and EAP

- Include the climate change impacts and the climate change risks on projects; in other words, it should include provisions for both **mitigation** of greenhouse gases and **adaptation** to the impacts of climate change.
- Account for cumulative environmental effects, both geographically and temporally. **To the extent reasonably possible, downstream greenhouse emissions should be included, whether they occur in Canada or outside the country.**
- Make provision for "**no net loss**" of habitat/natural landscapes over the life of the project. Including provision for future habitat anticipated to be lost due to climate change. For example, provision for additional habitat to off set future losses due to **sea level rise** or **flooding** due to climate change.

Addressing Public Perception

- **Legacy sites**, including sites not subjected to an EAP, that the public perceives to have been not adequately decommissioned or restored, should be in scope. Enhanced industry orphan funds, linked to new projects, should be considered to address legacy sites. Ensure that **decommissioning** and **restoration** is consistently completed to increase public trust.
- Public perception that compliance with existing regulations or permits is inadequate should be a focus. The EAP should specifically address the issues of **compliance and enforcement**, ensuring that adequate resources are available.
- Require **ongoing monitoring** of environmental impacts and take remedial action should the impacts exceed those agreed upon.

Improving Efficiency

- Provide for a single comprehensive assessment process that is a **multi-jurisdictional** process and considers climate change.

Wrap Up

Professional Engineers and Geoscientists of BC

- APEGBC thanks you for this opportunity to present to the Expert Panel
- For further information or any questions with regards to this submission please contact:

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