What does it mean to be the Engineer of Record (EoR) for a Tailings Storage Facility (TSF)?

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Morrison Solutions, Inc.

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D’Appolonia Engineering
Division of Ground Technology, Inc.

Paul Ridlen
Knight Piésold and Co.
Setting the Stage…
Post Mount Polley
Canadian Dam Association (CDA) Works to Address Issue

- CDA established a Mount Polley Task Group
  - Members of Dam Safety and Mining Dams Committees
  - Coordinate follow-up to the Mt Polley Panel Report
- Task Group made recommendations to CDA:
  - Regulatory roles and responsibilities
  - Improving tailings dam safety (BAPs, BATs)
  - Revisions to FS criteria
  - Assessment of consequences of dam failure
  - Improve definition of the EOR
BCMEM
Works to Address Issue

- Following the Mount Polley TSF breach and recommendations in the Panel Report
- British Columbia’s Ministry of Energy and Mines (BCMEM)
  - Revised Health, Safety and Reclamation Code for Mines (i.e., Mining Code)
  - Contains new tailings management requirements
  - Released in July 2016
  - Several key legislated requirements for TSFs in BC
ICMM – TSF Position Statement

In December 2016, released position statement establishing ICMM’s framework for the governance of TSFs:

1. Accountability, responsibility, and competency
2. Planning and resourcing
3. Risk management
4. Change management
5. Emergency preparedness and response
6. Review and assurance
US Agencies Position on EoR

- TSFs must comply with regulations and be permitted.
- State & federal programs that include EoR requirements, typically:
  - Design certification by a PE
  - Designation of EoR during construction
  - EoR or PE certification of construction and operation
  - Inspection (annual to 5-year) by a PE
- Programs generally include requirements for: design report, plans & specifications, OMS manual, EAP, inspections and reporting.
- EoR qualifications generally reference licensure as a PE (some cite experience in the type of dam and specific knowledge/experience for certain submittals)
US Agencies Positions on EoR

Organizations and agencies with initiatives on the EoR designation for TSFs:

- ASDSO Initiative: Tailings Dams Regulatory Committee; Survey of States with EoR requirements; Position on Engineering Certification
- Montana DEQ Program: EoR, third-party review and independent review panel qualifications, responsibilities, reporting, and succession
- Federal agency programs (MSHA, OSMRE, USEPA)
Answering the Call… The Journey Begins
What does Engineer of Record (EoR) Mean?

- The term fits nicely in a box
  - Poorly defined and subject to loose and self-serving interpretation
- Is it a single person, a group and company?
- Is it then Owner or outside engineer?
- How does it address for a transient design?
- How does the concept address change?
- Operational life that extends through generations?
- Is it sustainable?
GBA’s Tailings EoR Task Force

Our Mission:
Raise awareness among the GBA member firms that perform tailings storage facility design services of the concerns and issues related to Engineer of Record (EoR) for these ever-changing facilities.

- Our mandate:
  - Perform outreach to industry, other organizations, and regulatory agencies, as appropriate, for feedback
  - Develop guidance documentation defining roles/responsibilities of the EoR
Task Force in Action…

ADDRESSING THE ISSUE OF ENGINEER OF RECORD FOR TAILINGS STORAGE FACILITIES
Kimberly Finite Morrison, PE, RG and Christopher N. Hatton, PE

THE ISSUE
Many of GBA’s member firms provide consulting services to the mining, oil sands, and power sectors. A niche within those industries is providing design, construction, operational support, and closure of Tailings Storage Facilities (TSF), work that is often performed by geotechnical engineers.

The broadly used term, Engineer of Record (EoR), is applied universally, but interpreted differently by owners, regulatory agencies, and professionals working in the industry. TSFs are an ever-expanding and complexable, yet necessary and ongoing, aspect throughout the life of mining operations and post-closure. These tailings can have service lives that transcend generations as they pass between owners through acquisitions and divestiture, and are subject to the inherently transient system of engineering firms responsible for tailings management.

The Mount Polley (Canada) tailings dam failure in August 2014 and Rossing (Namibia) tailings dam failure in November 2011 have called into question the EoR paradigm for owners, regulatory agencies, and engineering firms alike, who are looking for guidance on how to approach management of these evolving and ever-changing facilities. In mid-August 2016, yet another tailings failure occurred—this time at Xingsheng West Alumina’s tailings storage facility in the Inner province of China.

TAILINGS EoR TASK FORCE - OUR MISSION
The Geotechnical Section Council (GSC) has established the Tailings EoR Task Force to tackle this issue head-on.

GEOPROFESSIONAL BUSINESS
ASSOCIATION
www.geoprosociety.org

Tailings Dam Engineer of Record (EoR)
There's Nothing Conventional About It...

Engineer of Record (EoR) is a simple and absolute concept that’s applied throughout the western world for civil works construction. It’s a term that fits in a nice neat box; it represents a single person who is solely responsible for engineering design. But how can the EoR concept be applied to a transient design—one that implements the observational approach with a construction life that can span decades, often exceeding a design engineer’s career or lifetime, and one that is directly impacted by changes in the state of practice? This is where the EoR definition becomes foggy. The roles and responsibilities of the EoR are interpreted differently by owners, regulatory agencies, and design professionals, based, in part, on experience or legal interpretation. This disparity is no more prominent than in the mining industry.

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Tailings EoR Workshop
January 26, 2017 – Denver, CO
Tailings EoR Workshop – Purpose

- Learn from each other through experience and case histories:
  - One Size Does Not Fit All – EoR Legacy Design and Scalability
  - State and Federal Government EoR Positions & Initiatives
  - Engineer of Record – An Owner’s Perspective
  - EoR – Canadian Evolving Practice
  - USSD Tailings Committee Update
  - A Consultant’s Perspective on EoR Responsibilities
  - Overview of the Association of State Dam Safety Officials
  - Current Requirements for Tailings Dam Engineers in Alaska
  - Tailings Engineer of Record (EoR), Oil Sands Dam Safety Practice in Alberta Canada Regarding the EoR
  - GBA’s Tailings EoR Task Force Mission, Workshop Objectives & Insurer Concerns Pertaining to Tailings Work
Tailings EoR Workshop – Purpose

- Learn from and obtain alignment with other organizations on the issues surrounding EoR for TSFs:
Tailings EoR Workshop – Purpose

- Review results of a detailed pre-workshop survey
Tailings EoR Workshop – Purpose

- Participate in facilitated break-out sessions
Pre-Workshop Survey – Demographics & Experience

Survey Response
- Period: January 2017
- 51 Responses Received
- 23 Engineering Firms
- 2 State Regulatory Agencies
- 2 Mining Companies

Years of Experience

![Bar chart showing years of experience](image)
Pre-Workshop Survey – Demographics & Experience

Type of TSF

![Bar chart showing relative number of TSFs by type and involvement]
### Elements of projects with EoR services

<table>
<thead>
<tr>
<th>Service</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issued for Const. Plans and Specs.</td>
<td>82%</td>
</tr>
<tr>
<td>Geotechnical Site Characterization</td>
<td>81%</td>
</tr>
<tr>
<td>Conceptual / Feasibility Level Design</td>
<td>80%</td>
</tr>
<tr>
<td>Borrow Material Characterizations</td>
<td>77%</td>
</tr>
<tr>
<td>Dam Safety Reviews</td>
<td>70%</td>
</tr>
<tr>
<td>Surface Water Mgt. Plans</td>
<td>69%</td>
</tr>
<tr>
<td>Operational &amp; Maintenance Manual</td>
<td>61%</td>
</tr>
<tr>
<td>Site-Wide Water Balance Analysis</td>
<td>63%</td>
</tr>
<tr>
<td>Closure Plans &amp; Cost Estimates</td>
<td>60%</td>
</tr>
<tr>
<td>Scheduled Updating of Closure Plans</td>
<td>41%</td>
</tr>
<tr>
<td>Regulatory Compliance Program</td>
<td>44%</td>
</tr>
<tr>
<td>Failure Modes and Effects Analysis</td>
<td>35%</td>
</tr>
<tr>
<td>Environmental Mon. &amp; Resp. Plan</td>
<td>32%</td>
</tr>
<tr>
<td>Risk Analysis</td>
<td>24%</td>
</tr>
<tr>
<td>NI 43-101 Reports</td>
<td>33%</td>
</tr>
</tbody>
</table>

Legend:
- Frequently or Always
- Occasionally
- Infrequently or Never
- Don't Know or N/A
## Concerns with providing EoR services

<table>
<thead>
<tr>
<th>Issue</th>
<th>% of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process to Implement EoR Recommendations</td>
<td>49% 31% 13% 7%</td>
</tr>
<tr>
<td>Documentation on Tailings Production and Processing</td>
<td>47% 40% 9% 4%</td>
</tr>
<tr>
<td>Verification of Tailings Characterization &amp; Design Parameters</td>
<td>52% 33% 9% 7%</td>
</tr>
<tr>
<td>EoR Approval of Design Modifications during Construction/Operations</td>
<td>46% 39% 9% 7%</td>
</tr>
<tr>
<td>Definition of Scope of Work</td>
<td>41% 43% 11% 4%</td>
</tr>
<tr>
<td>Documentation on Work Performed by the Preceding EoR</td>
<td>34% 53% 2% 11%</td>
</tr>
<tr>
<td>Process for Continuation of EoR Services</td>
<td>29% 47% 18% 7%</td>
</tr>
<tr>
<td>Tailings Variability</td>
<td>30% 47% 17% 6%</td>
</tr>
<tr>
<td>Capabilities of Other TSF Project Participants</td>
<td>30% 48% 15% 7%</td>
</tr>
<tr>
<td>Environmental Issues</td>
<td>20% 54% 22% 4%</td>
</tr>
<tr>
<td>PE (or PEng) Certification Requirements</td>
<td>24% 27% 38% 11%</td>
</tr>
<tr>
<td>Idling or Closure with Hiatus in Operation</td>
<td>13% 49% 27% 11%</td>
</tr>
</tbody>
</table>
### Concerns & Strategies for EoR services

<table>
<thead>
<tr>
<th>EoR Concerns</th>
<th>EoR Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition of EoR Scope of Work</strong></td>
<td>• Communication</td>
</tr>
<tr>
<td></td>
<td>• Reference to State of Practice</td>
</tr>
<tr>
<td></td>
<td>• Identification of Roles &amp; Responsibilities</td>
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<td></td>
<td>• Contract Language</td>
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<tr>
<td><strong>Process to Implement EoR Recommendations</strong></td>
<td>• Addressed in Scope of Work</td>
</tr>
<tr>
<td></td>
<td>• Participation of Independent Review Panel</td>
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<td></td>
<td>• Reporting Responsibility</td>
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<tr>
<td><strong>Approval of Design Modifications during Construction / Operation</strong></td>
<td>• Distinction between Minor and Major Modification</td>
</tr>
<tr>
<td></td>
<td>• Definition of Modification and Extent of Approval</td>
</tr>
<tr>
<td></td>
<td>• Conducted under a Risk Management Plan Acceptable to Owner and Regulator</td>
</tr>
</tbody>
</table>
# Concerns & Strategies for EoR services

## EoR Concerns

<table>
<thead>
<tr>
<th>Process for Transition/Continuation of EoR Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Dam Safety Reviews</td>
</tr>
<tr>
<td>• Project Documents &amp; Design Reviews; QA Checks</td>
</tr>
<tr>
<td>• Independent Assessment of Potential Risks</td>
</tr>
<tr>
<td>• EoR Team within Firm and Succession Planning</td>
</tr>
</tbody>
</table>

## EoR Strategies

<table>
<thead>
<tr>
<th>Verification of Tailings Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Addressed in Scope of Work</td>
</tr>
<tr>
<td>• Reference to State of Practice</td>
</tr>
</tbody>
</table>

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*CPT Rig for Tailings Characterization*
Value provided by a competent EoR

• Continuing involvement of the responsible engineer having in-depth knowledge of the TSF, capable of implementing the observational approach to ensure the design philosophy and intent is met over the life of the project

• Delivering leadership across disciplines, providing a resource for the owner in making sound technical and business decisions

• Demonstrating owner’s commitments to safety and sustainability to project stakeholders

• Fulfilling regulatory requirements and ensuring QA/QC programs are implemented, project documentation is completed, and inspections are conducted and submitted

• Confirming understanding of owner's staff of the proper methods of operating the facility and

• Prepared to respond should adverse conditions develop
EoR qualifications for TSF projects

• Consensus among workshop attendees:
  • 10 years minimum relevant experience (more as complexity or scale increases)
  • PE in jurisdiction of project, as applicable
  • Relevant experience in TSF design/construction/operations
  • 5+ years of experience managing multi-disciplinary tailings projects

• Excerpt from DIAC’s June 2017 White Paper:

The qualifications and experience of the DE and EOR must be commensurate with the risk and complexity of the dam. A typical minimum requirement is a relevant professional undergraduate and/or graduate degree, and 10 years of relevant experience in the design, construction, performance evaluation and/or operation of dams. Additional experience is needed for responsibility for high risk or complex structures. Significant engineering judgment and discretion is required in these roles.

The DSRE, EOR and DE must be registered Professional Engineers in Alberta.
Roles & Responsibilities

- Developed preliminary RACI charts
- Project phases: design, construction, operations & closure
Roles & Responsibilities

- Excerpt from DIAC’s June 2017 White Paper:
  - RASCI charts for: (i) large organizations with multiple dams and sophisticated internal resources; and (ii) small organizations with few dams and limited internal resources.
Looking to the Future…
Where are we now?

- A small professional community with niche skills
- Experiencing resource redistribution
  - Cyclic attrition during down markets
  - De-emphasis of engineering
  - Movement to State and Federal jobs
  - Private sector recruitment
- Attrition (Father Time Yields for No One)
- Require continual “on-the-job” training
Resource Demands

- Ownership
  - Program Director - “Corporate Champion”
  - Internal engineers

- External Reviews
  - EoR direct engagement
  - External support
  - 3rd party reviewers

- Technical Review Boards
  - Academia or private practice experts
Legacy Planning

- Sufficiently flexible EoR requirements
  - Problem recognition
  - Utilize teams to leverage resources
  - Scalability
  - Data warehousing
  - Attrition planning
Sustainability Cycle

From Morrison and Hatton, “Tailing Dam Engineer of Record (EoR) There’s Nothing Conventional About It”
Culmination of Task Force Efforts

“Best Practices for the Engineer of Record (EoR) for Tailings and Other Mining Dams”

- Assists in identifying the roles and responsibilities of the EoR
- Provides guidance to assist in establishing a standard of care for work in the United States and elsewhere in the world

Document contributed to by:

- CDA
- ACB
- USSD
- CANADA'S OIL SANDS
Thank You!