

What it Means to be an Engineer of Record

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Abstract:

The term Engineer of Record (EoR) is commonly used in North America to define the responsible person for design and construction phases of a project. For tailings storage facilities (TSF's), an EoR is often appointed as the person technically responsible for seeing that a TSF is built according to the design. The use of this appointment has increased due to recent high profile TSF failures, and has spread to countries outside of North America, especially for mining companies that are based or listed there. Recent updates to national/international TSF guidelines suggest appointing an EoR is good practice.

TSF's are built over many years, so the initial capital construction phase is often well supervised according to design drawings and technical specifications, but then enters a commissioning and operation phase, before reaching a closure phase. It is during these multiple year phases, where deviations from the design are possible, and often the operation is undertaken by the Mine or a third party contractor who may not always appreciate the implications of poor operation/construction. Since the EoR is not on site full time, how can he/she take on such an appointment and responsibility for anything that might go wrong? The only way this is possible is if the EoR is given greater authority. This paper discusses whether an EoR should accept the appointment, and if an EoR is appointed, what responsibilities and authority he/she should accept.

Keywords: Engineer of Record, Tailings Storage Facilities, Responsibility, Authority

1. Introduction

While appointing an EoR makes sense as a way of ensuring responsible tailings management from cradle to grave for each TSF, and is good practice, in a Southern African context, it is a potentially daunting role. There is a significant difference between engineering and construction to first world and third world standards, and in Southern Africa the full range is possible, depending on the Mining Company and the competence of its people. There are a number of key considerations before accepting such a role;

- Who is the client, and will they fully support proper design, commissioning, operation and closure of their TSF throughout its life?
- Who will operate the TSF, and do they understand the importance of good operation, and do they have the personnel to execute continuously good operation?
- If there has been a previous designer/consultant, does the new EoR accept full responsibility?

2. Roles

2.1 The Client

The client plays a very important part in the EoR role, and ideally this should not vary whether it is a Mining Junior, to Mid-Tier Miner, to a Mining Major. If the client has internal tailings standards and has good staff with an understanding of TSF's and their management, this makes it easier for a consultant to accept the EoR appointment. If the client comes from a First World country, and are listed on their local stock exchange, they often adopt their home country standards or require that international standard be applied on projects in other countries. However, if this is not the case, the risks may include;

- Budgets for consulting work may not be in place or adequate, resulting in inadequate design, site inspections, meetings, ongoing advice and stability analyses,
- Budgets for operating and/or expanding the TSF may not be in place, potentially resulting in compromised freeboard, stability, or environmental impacts,
- High staff turnover and personnel put in charge of TSF's are not trained in managing them, resulting in poor continuity of knowledge and planning, and poor decision making,
- TSF's in Southern Africa have traditionally been upstream, self-impounding designs that rely upon sun drying of the tailings for stability. This is a very cost-effective design, which is attractive to clients, but is risky if not well operated, and more so now that lined TSF's are being designed and built, and
- TSF's in Southern Africa have also traditionally used gravity penstocks to decant supernatant water as this is a low cost system, however these are prone to failure with serious implications to the TSF and potentially the EoR's liability.

The recent low commodity price cycle has been a case in point where Clients have asked Consultants to cut back on monitoring services or delay stability investigations and analyses, offer discounts on design and other services, and to continue with traditional designs. This can undermine the service provided, new industry standards and professionalism (ethics of the industry). TSF's should be one area where costs and standards are not cut due to the consequences involved.

2.2 The Operator

The TSF operator, whether it is the Mine itself, or a Contractor, is critical to good operation. Where a competent person, team or company is employed, the risks of poor operation are reduced. However, where this is not the case the risks are;

- Poor commissioning which could compromise under-drains, fines deposition against the outer walls, and other actions that are non-compliant with the operating manual,
- Poor deposition during operation, affecting beaching and stability,
- Poor water management, affecting freeboard and statutory/permit conditions,
- Poor wall raising, leading to freeboard or stability issues,
- Inadequate slurry pumping capacity, leading to an inability to pump to the furthest points,
- Poor training of site staff, leading to non-compliant operation, and
- Poor quality site equipment, leading to low availability and delayed site tasks.

For an EoR to take on his role, a good operator and his personnel, is a critical part of the team. Without this, the EoR is exposed and any advice provided to the client may not be executed. The Operator is on site full time, while the EoR only visits the site periodically, by which time damage done may be covered or masked by new deposition.

2.3 The Consultant

A Consultant taking on the EoR role also has to consider his capacity and staff compliment to support him. Typically, the client is looking to appoint an individual within a company on the basis that the individual has good experience, and is supported by a good team. In South Africa, Consultants can go through significant staff changes due to economic and political changes, and the brain drain of all levels of staff is a real factor. It is not easy to find experienced staff who can take on the EoR role, as the EoR cannot typically be a recently certified Professional Engineer with <10 years' experience. This will limit the number of EoR appointments a Consultant can take on, as they will need multiple teams to support each and every appointment. Therefore, it may not be possible for small Consulting companies to take on more than two large (or five small) appointments and fully service their clients (in addition to other work). It may be necessary for Consultants to approach external parties (international specialists or retired professionals) to assist with EoR duties, rather than relying on their own internal resources.

3. Risk Management

3.1 The Consequences

Having considered the client and operational context, the prospective EoR has to consider the risks and consequences of what would happen if something did go wrong. In the early design stages when a client is simply looking at the feasibility of their project, there is minimal risk prior to any permit or detailed design stage. Once the implementation phase commences, each

and every Consultant involved in the design, commissioning, operational and closure phases is then potentially a party to any failure of the facility, which may not be limited to slope failure, but environmental damage and health impacts. If the Client changes EoR at any time, both EoR's could be liable, and the client or other affected parties could sue for damages.

The EoR needs to make sure they not only have sufficient insurance cover, but may also need regular legal advice before entering into EoR agreements. Equally getting legal advice would be required prior to resigning as an EoR at a particular site, or accepting a new role as EoR for an existing TSF. Legal advice might also be required when a Client changes the EoR based on a tender process. The outgoing EoR may not automatically discharge his liability because the Client appoints a new Consultant, and a formal letter may be required to limit liability once the new EoR takes over.

The consequences of a TSF failure range from fines and penalties, to imprisonment for not only the EoR, but other personnel from all parties involved. In addition, if an EoR is found to be liable, they may be stripped of their professional registration and be banned from working in the industry or geotechnical field.

One question the Consultant might have to ask is; What happens if a Client appoints a Consultant to design their TSF and then retains them during the operational life, and this Consultant only has a commercial appointment (not EoR). Does this Consultant have any different standing in the event of a failure? Probably not. The paper addresses this later.

3.2 The Way Forward

The status quo of continuing to design, construct and operate TSF's in the same way as we always have, has to change. There are too many failures to allow this, and someone or a team or persons, must take responsibility. TSF's are complex geotechnical structures that change with time, and require ongoing involvement of engineers to ensure that their design intent is followed, and if the design is inadequate for any reason, for it to be changed to meet all regulatory and stability requirements. For this to happen, the EoR has to be given **AUTHORITY** to intervene when deviations take place.

In the South African Context, the Mine Health and Safety Act (MHSA, Act No. 29 of 1996) Section 7(4) read in conjunction with Regulation 2.6.1 of the Minerals Act No. 50 of 1991, provides for the General Manager of a mine who has a Section 3(1) appointment to delegate responsibility for operating the mine to managers. The Plant Manager has a 2.6.1 Appointment, and the Engineering Manager is appointed in terms of 2.13.1. The Plant Manager typically delegates technical responsibility for the TSF aspects to a competent person (Consultant/Designer) as the 2.6.1 Appointment limited to his off-site capacity. The TSF operator would normally be appointed in terms of 2.6.1 but may also have a 2.13.1 Appointment for their responsibilities (on-site support and advice). The 2.6.1 Appointment is limited to off-site tasks since the infrequent visits to the operation makes it impossible to be responsible for operational activities. The Competent person or Consultant typically has generated all design reports and Operating Manuals. The competent person under the MHSA is defined as;

- a) Is qualified by virtue of his knowledge, training, skills, and experience to organize the work and its performance,
- b) Is familiar with the provisions of the MHSA (including applicable subordinate legislation) which apply to the work to be performed, and
- c) Has been trained to recognize any potential or actual danger to health or safety in the performance of the work.

South African Consultants are therefore familiar with 2.6.1 Appointments, and where a client requires an EoR, this does not appear to be much different, but it has to be.

4. EoR Definitions

There is no universally accepted definition, and the term is not universally applied. A few examples are as follows;

The Mining Association of Canada (MAC) stated in its document "A Guide to the Management of Tailings Facilities" that

"The mining industry has the technology and resources to safely site, design, construct, operate, decommission and close tailings facilities, but there remains a need to continually improve their management in a consistent safe and environmentally responsible manner through the full life cycle. The EoR as defined herein will serve to elevate the safe and environmentally responsible management and its consistency through the full life cycle".

In the State of Florida Administrative Code, the following definition is provided for an EoR:

"A Florida professional engineer who is in responsible charge for the preparation, signing, dating, sealing and issuing of any engineering document(s) for any engineering service or creative work."

The US National Society of Professional Engineers (NSPE) defines “Responsible Charge”, which is the role that the “Responsible Engineer” is to play, as quoted below.

“In matters involving engineering services and engineering service providers, it is the position of NSPE that the public health, safety, and welfare is best served by having qualified licensed professional engineers in "responsible charge" of the engineering services.”

For purposes of this statement the term "responsible charge" means the degree of control an engineer is required to exercise over engineering decisions made personally or by others over which the engineer provides supervisory direction and control authority. In making and approving engineering decisions, the engineer should be physically present or, if not physically present, be available in a reasonable period of time, either personally or through the use of electronic communication devices. Responsible charge and direct supervision are not satisfied with drawing or other document review after preparation without involvement in the design and development process as described above. Further:

1. An engineer in "responsible charge" should be capable of answering questions relevant to the engineering decisions made as part of the engineer's professional services with such answers being in sufficient detail to demonstrate reasonable knowledge of and proficiency with those engineering issues related to the services provided.
2. An engineer in "responsible charge" should be completely in charge of, and satisfied with, the work product of the engineering services rendered. Additionally, an engineer in "responsible charge" should have and exercise the authority to review and to reject or approve both the engineering work in progress and the final work product.
3. An engineer in "responsible charge" should also have personal knowledge of the technical abilities of personnel doing the work and be satisfied the technical credentials of such personnel are suitable for the performance of the work.
4. By affixing one's engineering seal to the product of one's professional services, the engineer in "responsible charge" should be deemed to have exercised that degree of control and supervision described above and should accept full responsibility for the work product content”.

To apply the EoR definition to TSF's (and equally other mineral residue fields such as heap leach pads), an attempt has been made to summarize what it could/should cover. It is thought best to split the EoR role into aspects of Authority and Responsibility, as outlined below.

5. Onerous EoR Appointment

5.1 Authority

In order to serve as the EoR for a TSF, and possibly a heap leach pad or mine water pond, the EoR must be granted authority and provided with sufficient time, budget and resources to:

- design the facility in accordance with applicable laws, appropriate industry standards and as appropriate for the site conditions,
- provide sufficient oversight during construction of all stages to confirm that the facility has been constructed in conformance with the intent of the design and specifications, and
- provide sufficient oversight during the operation of all stages, including geotechnical and hydraulic monitoring and conducting regular, on site, visual inspections to confirm that the facility is being monitored and managed in accordance with the intent of the design, which may have been modified to suit any changed conditions.

Should the EoR not be able to carry his duties due to the Client not allowing them, or the Client is not operating the facilities in line with the design intent, and safety or stability is compromised, the EoR should have the authority to instruct the most senior person at the operation to stop or modify operations, until the EoR is satisfied that they can continue normally. If this instruction is ignored, the EoR should have the right to withdraw services, but not before informing the Regulators (and possibly affected communities and emergency services) of the situation. The contractual terms of the EoR Appointment should be written to this effect, such that Client personnel understand that the EoR can request production be stopped under certain conditions.

Typically, threatening situations on a TSF do not happen overnight, and there are multiple warning signs of deterioration. In such cases, the EoR would have the opportunity to warn the Client of the issues, and recommend actions to avert further deterioration. Initially these recommendations would be sent to the Plant and Engineering Managers, then to the Mine Manager, and if inadequate response is taken, a more senior company representative would be contacted. Only after such a

process has been exhausted, would the step of instructing that operations stop, be taken. This level of authority must be written into the EoR appointment.

5.2 Responsibility

The EoR must assume responsible charge for the technical aspects of the project or a specifically agreed portion of the project that the EoR agrees contractually to undertake, including the design, construction and operational aspects. In assuming responsible charge, the EoR must, to the best of his/her ability:

- make design, construction and operating decisions that are safe and environmentally responsible, follow the intent of the design and are appropriate for the conditions,
- be completely in charge of, and satisfied with, its work including its service, and exercise the authority to review and reject or approve the work and service,
- exercise that degree of control and supervision to accept full responsibility for its work and service,
- answer questions relevant to the design, construction and operation adequately, with such answers being in sufficient detail to demonstrate reasonable knowledge of and proficiency of the design, construction and operation, and
- have personal knowledge of the technical abilities of its personnel doing the work and be satisfied that the technical credentials of such personnel are suitable for the performance of the work, are in accordance with applicable laws and are consistent with industry standards.

The EoR should request continuity of this responsibility into the post-closure phase, which would then include the closure design and construction supervision.

Since an operational TSF is constantly being constructed, how can the EoR take responsibility if not on site full time? Are part-time monitoring and site visits adequate to accept responsibility? The only way this can work is if the EoR is given sufficient opportunity by the Client to test, measure and analyse stability during its life. Data supplied by the Client and Operator are a key part of this process. If good data is available, and adequate analyses are carried out, the EoR should be able to satisfy himself that the TSF is safe and stable, or where necessary what remedial actions are required to achieve this.

6. Case Studies

This section of the paper considers a few examples of where failures have occurred and what the consequences were for the Consultant/EoR.

6.1 Mount Polley TSF

At no point does this paper intend to apportion any blame, but tries to highlight what happens when there is a change in EoR, and how this impacts the parties when something goes wrong.

- Knight Piésold Consulting (KP) was the EoR from design stage (1995 onwards) but withdrew its services in December 2010. A letter was sent to the Mine and copied to the Government of British Columbia's Chief Inspector of Mines formalizing this withdrawal (resignation). KP was not replaced as EoR because of a tender or non-performance issue.
- The Client appointed AMEC as the new EoR in February 2011.
- The new EoR altered the construction sequence of the KP design, resulting in temporary steeper outer slopes, with the intent of achieving the design slopes by buttressing later.
- The Client stored excess water on the TSF, and was unable to obtain a permit to discharge surplus dirty water (positive water balance). The Client was in the process of putting in place water treatment measures, and needed a temporary relaxation of the permit to allow some discharge until this was in place. It was not relaxed by the regulators and the Client had no option but to store it which was contrary to the design intent. The excess water may have contributed to the failure. The EoR may have had the authority to stop operations, but did not exercise it.
- Slope failure occurred on 4th August 2014.
- KP was identified as a potential guilty party as the original designer. The inferences are that the design was faulty and the new EoR had not taken on the responsibility of checking the previous design or alerting the Client as to why it was deficient.
- Independent Expert Review report into the failure stated that had the wall raising been built as per KP design, it would not have failed (even taking into account the weak glacio-luicustrine layer in foundation).

- The Client has sued KP for not recognizing the weak layer, even though the original KP geotechnical investigations had identified it and incorporated it in the design (stability analyses).
- Legal action still in process and the courts will decide for us. Hopefully the findings will inform us on how this EoR role should work.

Based on this example, a number of difficult questions arise;

1. What more could KP have done as the EoR to relinquish their responsibility?
2. Is the old EoR still responsible once new EoR appointed? If so does this ever expire?
3. Is the new EoR only responsible for new work, or does he/she take on the full responsibility?
4. If KP had known that the slopes were being steepened and large volumes of water were being stored on the TSF, could they have intervened?

6.2 South African TSF Failure Example

The Consultant on this TSF was not appointed as an EoR or as the 2.6.1. appointee. However, they were the designer and had a commercial contract to monitor the TSF and attend quarterly meetings (the formal scope of work). During the early phases of developing the TSF, the Client did not act on the Consultants requests to upgrade the slurry pumping system, and hence deposition to all areas was not possible, and the correct deposition plan could not be followed. The Consultant highlighted this in the minutes of the meetings, then wrote letters, held extra meetings with more senior management, all to no avail. Then a slope failure occurred (in mid-winter or dry season), fortunately only an outer wall slump, that allowed it to be repaired and buttressed within minimal interruption to production. However, the pumping system was not upgraded and poor operation continued despite further requests. Five months later the same section of the main wall was overtopped in the rainy season.

The questions here are;

1. Should the Consultant have resigned prior to or after the initial slope failure?
2. If the Consultant had resigned, would the Client have recourse to them for the subsequent overtopping failure?
3. If the Consultant had issued an instruction to stop production until the issues were resolved, would it have been accepted?
4. After the first slope failure, should the Consultant have requested that they be given greater Authority?

This is a case where the Consultant had little to no authority, and ultimately when overtopping did occur, the Client fortunately took no action against the Consultant, except to request help. It could have been different in another country and if the downstream consequences were different, and the Consultant may have been exposed to significant liability for not taking enough action.

7. Conclusion

South African Consultants are familiar with 2.6.1 Appointments, but where a client requires an EoR, the difference is that the EoR must be given authority, otherwise the industry has not moved forward. This authority must be written into the appointment, and allow the EoR to instruct the mine to stop operations when an unsafe condition has been reached, until it have been satisfactorily attended to.

When an EoR is appointed, they have to recognize that they have to take on full responsibility for the design, regardless of previous designs and analyses undertaken by other Consultants/EoR. The appropriate level of technical support is required by the EoR and his/her team, which should extend to adequate site inspections, monitoring, follow up investigations, testing and analyses, construction supervision and quality control. The Client needs to plan, budget and manage this work to make sure it is competently carried out, and the appropriate actions are taken by a good operator and/or other contractors.

There are a number of unanswered questions related to when a Client changes the EoR, and when an EoR resigns, does the original EoR still carry some responsibility? The Mount Polley TSF failure may in time provide some guidance, but for now, while we wait for the courts to decide, caution should be exercised in these situations, and legal advice sought.

References

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