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Dear Mark,

## RE: EOR Response to the Written Comments of Atlantic Richfield Company (ARCO) Relating to DEIS

## 1.0 INTRODUCTION

Montana Resources, LLP (MR) requested comments from the Engineer of Record (EOR) of the Yankee Doodle Tailings Impoundment (YDTI) in relation to the May 2, 2019 letter (ARCO letter) from Patricia Gallery (ARCO VP) to Mr Craig Jones (Department of Environmental Quality, DEQ). The ARCO letter provides written comments from Atlantic Richfield Company (ARCO) on the Draft Environmental Impact Statement (DEIS) prepared by DEQ in relation to the planned continued use of the YDTI. The MR request was initiated by a letter from Dan Walsh of the DEQ to Mark Thompson of MR on June 4, 2019, which requested a written response from the EOR and Independent Review Panel (IRP) in relation to comments contained in the ARCO letter.

The YDTI was originally constructed in 1963 and the embankments have been progressively constructed using rockfill derived from the Berkeley Pit (until 1982) and from the Continental Pit (beginning in 1986). The YDTI comprises a valley-fill style tailings impoundment created by a continuous rockfill embankment that is up to 800 ft high at the tallest section. The drained tailings beach is considered part of the impoundment containment system, which collectively with the rockfill embankment, contains the supernatant pond along the northern side of the facility. ARCO, the previous owner and operator of the YDTI, ceased operation of the facility in 1983. MR began operating the YDTI in 1986 and has gradually increased the tailings elevation by about 200 feet since that time.

Knight Piésold's (KP's) involvement at the YDTI commenced in 2012/2013 as part of a Failure Modes Assessment workshop. KP's responsibilities for the on-going design and development of the YDTI were formalized in 2015, when Mr. Ken Brouwer, PE agreed to accept the role of EOR for the Tailings Storage Facility (TSF). KP has since been actively involved in the design and development of the YDTI and has worked closely with MR to achieve the fundamental objective of on-going continuous improvement of the safety of the impoundment.

## 2.0 OVERVIEW

### 2.1 RELEVANT MONTANA LEGISLATION

The 2015 revisions to the Montana Metal Mine Reclamation Act (MMRA) are recognized by many in the international mining community to be one of the best and most progressive examples of tailings legislation

in the world. The roles, responsibilities and duties of the various parties involved in the design, construction, operations and closure of either a new TSF or for an expansion to an existing TSF, are provided in Montana Code Annotated (MCA) Sections 82-4-375 to 381.

Operator: MR is the operator and permit holder for the YDTI.

Engineer of Record (EOR): Mr. Ken Brouwer, PE is a registered Professional Engineer in Montana and is the designated EOR for the TSF as stipulated per MCA 82-4-375. The EOR reviews, certifies and seals YDTI designs or other relevant documents submitted to the DEQ. He is supported by the team of technical specialists at KP, and by additional external specialist sub-consultants as appropriate.

Independent Review Panel (IRP): An IRP, consisting of three independent review engineers, provides an important role in the review of the EOR's design, as well as in assessing the practicable application of current technologies in the design. The following three distinguished international experts need no introduction as they are highly reputable specialists in tailings management and have been approved by DEQ (as per MCA 82-4-377) to constitute the IRP for the YDTI:

- Mr James Swaisgood, PE – Dam and Seismic Specialist
- Dr Leslie Smith, P.Geo, - Hydrogeology Specialist
- Dr Dirk van Zyl, PE, - Tailings and Geotechnical Specialist

Recommended modifications that are provided by the IRP must be addressed by the EOR, before the IRP approves the EOR's design for the TSF. The IRP's determination is conclusive and binding for the EOR, the operator and the DEQ. The IRP must also conduct comprehensive periodic reviews of the TSF during on-going operations and after closure at an appropriate frequency. The IRP for the YDTI is updated with the most recent information relating to the on-going operation and monitoring of the facility.

Department of Environmental Quality (DEQ): The DEQ is updated concurrently with the IRP. They participate in the panel review, but are not a member of the panel and their participation is nonbinding.

### 2.2 OVERVIEW: YDTI OPERATION AND MANAGEMENT

The EOR along with the associated KP team are pleased with the progress that has been achieved at the YDTI, particularly during the period of time since our original involvement. KP carefully reviewed the status of the YDTI, prior to Mr. Brouwer's acceptance of the EOR responsibilities for the facility and determined that the impoundment had generally been developed responsibly and that it complied with dam safety requirements. It was also recognized that design and operating enhancements could provide further opportunities for risk mitigation, and these enhancements continue to be progressively implemented at the YDTI.

The EOR is satisfied that the YDTI is a stable impoundment that continues to be developed in a responsible manner in order to continuously reduce the potential for emergency conditions, both during operations and in the long-term following closure. The IRP has been instrumental in providing independent review and technical suggestions since 2015, and has concurred with the EOR assessments.

## 3.0 ARCO LETTER TO DEQ WITH THEIR COMMENTS ON DEIS

### 3.1 GENERAL

The ARCO letter to DEQ is lengthy and largely non-technical, and over half of the pages are expansive resumes for three engineers (Morgenstern, Davidson and Hippley) that ARCO has retained to provide

recommendations on *'data collection, monitoring, and early warning practices that should be employed at the YDTI and which adhere to best practicable engineering practices and emerging standards-of-care in the hard-rock mining industry'*. These engineers have apparently reviewed and commented on '*MR's permit amendment application materials and other available information relating to the current and projected future (post expansion) condition of the YDTI embankment*' and *'their recommendations are reflected in and provide support for'* ARCO's 'Comments' contained in the letter. However, a reviewed document list was not provided and therefore it is unclear what information has been made available to these engineers by ARCO to form the basis of their review and resulting opinions.

The ARCO letter alludes to recommendations and relies on reference to the distinguished careers of the three engineers retained in order to support the ARCO request for DEQ to incorporate a specific permit stipulation presented in Exhibit 1 of the ARCO letter. ARCO notes that *'the experts' evaluations necessarily depended on the type and quantity of data available to them',* and KP agrees that the basis of the recommendations alluded to is fundamental to the usefulness of the recommendations. However, it is not known what opinions were expressed and what specific recommendations were made by these engineers because no supporting technical report was provided with the ARCO letter and no collaboration or consultation with the EOR and IRP occurred during preparation of the recommendations. We will first provide comments on ARCO's proposed permit stipulation, and then briefly discuss the four supporting ARCO 'Comments' that are presented in the ARCO letter to DEQ.

KP welcomes more consistent constructive collaboration with technical personnel retained by ARCO and anticipates that more regular communication would be of benefit to the project and would help avoid unnecessary confusion.

### 3.2 ARCO PROPOSED PERMIT STIPULATION

In Exhibit 1, ARCO provides their proposed "*Permit Stipulation: Permits 00030 and 00030A*" where-in ARCO suggests certain specific requirements be stipulated as conditions of the Permits '*to support assurance of the integrity of the YDTI tailings storage facility and the protection of public health and the environment*'. We note that the expectations for protection of human health and the environment are fundamental requirements for the design, construction and operation of the YDTI as described in the Montana legislation. These expectations also represent fundamental principles of ethical conduct for registered Professional Engineers.

ARCO suggests that Permit Stipulations for the YDTI should include "*Failure Modes and Effects Analysis Monitoring*" and "*Early Detection Monitoring Systems*" for the YDTI. However, ARCO seems to be unaware that the stipulations they are proposing are already addressed through legislation, including in MCA 82-4-375 through 381.

#### 3.2.1 FAILURE MODES AND EFFECTS ANALYSIS MONITORING

The first component of the proposed Permit Stipulation is termed by ARCO to be *'Failure Mode and Effects Analysis Monitoring'*. The wording itself is misleading as it incorrectly amalgamates two separate procedures – 'Failure Modes and Effects Analysis' and 'Monitoring'. The wording in the proposed ARCO Permit Stipulation is also confusing as specific design objectives, site investigation techniques, field/laboratory data collection methods/objectives, operational monitoring, various reporting methods/protocols and review/approval processes are used together without reference to the existing regulatory framework. Furthermore, these items are already well represented in the legislation. The

following clarifications provide examples of specific requirements in the legislation that make the additional stipulations proposed by ARCO redundant.

Failure Modes and Effects Analysis (FMEA) is a tool that can be used as part of a risk assessment process. FMEA is one of the risk assessment options identified in the Design Document requirements in MCA 82-4-376(n). The Design Document supporting the Permit Amendment Application contained an appropriate detailed risk assessment report, entitled the Dam Breach Risk Assessment (DBRA), which was reviewed by the IRP and addressed the requirements of the MCA 82-4-376(n). The DBRA identified potential failure modes and included a detailed evaluation of each failure mode for normal operating conditions and considered failures of mechanical systems, malfunctioning management plans, and occurrence of extreme flood and earthquake events.

FMEA is also referenced in MCA 82-4-379(i) as a risk assessment option in relation to the development of the Emergency Preparedness and Response Plan (EPRP) section contained in the **Tailings Operations Monitoring and Surveillance Manual (TOMS Manual)**.

'Monitoring' is a broader requirement that is outlined in various sections of the referenced Montana legislation. The ARCO Permit Stipulation suggests that a document termed an *'Initial Failure Mode and Effects Monitoring Plan'* should be prepared for review and approval by the DEQ and IRP, and that every year an *'Annual Update Report'* should be prepared summarizing the data and analysis along with detailed monitoring plans for the next year. The suggested documents are already required by the legislation, have been prepared and/or reviewed by the EOR, have been provided to the DEQ and the IRP, and are subject to on-going review by the EOR, IRP, and DEQ.

1. **Tailings Operations Monitoring and Surveillance Manual (TOMS Manual)** as required in MCA 82-4-379. The legislated requirements for the TOMS Manual are extensive and among other requirements includes identifying requirements and frequency for inspections and monitoring to ensure that the tailings storage facility is operated and maintained, is performing, and can be closed as intended. The TOMS Manual is reviewed and updated annually by MR and KP, as required by the legislation, and any updated versions are certified by the EOR. Copies are retained in the offices of MR and the EOR, and updated versions are provided to the DEQ and IRP. The *'Initial Failure Mode and Effects Monitoring Plan'* is redundant based on the existence of the TOMS Manual, and annual changes to monitoring plans are captured in annual updates to the TOMS Manual.
2. **EOR Annual Inspection Report (AIR)** and the associated **Corrective Action Plan (CAP)** as required in MCA 82-4-381. An Annual Inspection of the YDTI and associated systems is conducted by the EOR, and an AIR is prepared per State law that provides recommendations for refinements to operating practices and monitoring protocols. MR prepares the CAP and the schedule for implementation of the recommendations, which is reviewed and verified by the EOR. These two documents are supplemented by an annual **Data Analysis Report (DAR)** prepared by the EOR for the YDTI that summarizes the performance monitoring and instrumentation data for the impoundment on an annual basis. The *'Annual Update Report'* is redundant based on the reporting procedures described above that are currently being implemented in accordance with the legislation.
3. These documents are subject to formal **Periodic Review** by the IRP as required in MCA 82-4-380 at a frequency chosen by the IRP, but not to exceed at least once every 5 years. The legislation includes in the Periodic Review the provision for review of TOMS Manual, annual EOR inspection reports, corrective action plans, records associated with construction, and any other aspect, plan, record, document, design, model, or report related to the tailings storage facility that the panel needs to review to ensure that the tailings storage facility is constructed, operated, and maintained as designed and is

functioning, can be closed as intended, and meets acceptable engineering standards. Any recommendations resulting from the review are binding and also require a **Corrective Action Plan (CAP)** to be prepared by MR (with approval by the EOR). The CAP proposed by MR must be reviewed and approved by the IRP, and then implemented by MR in accordance with the approved schedule.

This portion of the ARCO Permit Stipulation also contains a list of suggested site investigation techniques and field/laboratory data collection methods/objectives to be included in an initial monitoring program. The legislated requirements for site investigation and laboratory testing are included in the requirements for the Design Document in MCA 82-4-376 and are stated as follows:

- MCA 82-4-376(2)(f) requires 'a site geotechnical investigation commensurate in detail and scope with the complexity of the site geology and proposed tailings storage facility design… (It) must include a geological model of site conditions and a rationalization of the site investigation process;'
- MCA 82-4-376(2)(g) requires 'a demonstration through site investigation, laboratory testing, geotechnical analysis, and other appropriate means that the tailings, embankment, and foundation materials controlling slope stability are not susceptible to liquefaction or to significant strain-weakening under the anticipated static or cyclic loading conditions, to the extent that the amount of estimated deformation under the loading conditions would result in loss of containment;'

The site investigation and laboratory testing requirements for the Design Document supporting the Permit Amendment Application were met by completing several phases of geotechnical site investigations and laboratory testing over several years between 2012 and 2016 (KP, 2013, 2014, 2015, 2016a, 2016b, 2016c, 2016d, 2016e, and 2016f). The results of the site investigation programs were combined with existing available historical data collected by others to support characterization of the geotechnical and hydrogeological conditions at the site (KP, 2017a). The scope and findings of the site investigation programs were discussed with the IRP during meetings at various points during completion of the site investigation programs and characterization of the site.

This body of work was then subject to formal review by the IRP following submission of the Design Document. The IRP accepted the adequacy of the Design Document in November 2017, and they concluded in their Final Report (IRP, 2017) that they were satisfied that the scope of the investigations was sufficient to properly characterize the tailings, embankment and foundation materials. The IRP further recognized in their report that KP and MR had developed a plan for continuation of the phased site investigation programs to supplement the existing embankment monitoring network over a period of several years. The IRP requested to receive on-going updates on the results of the additional drilling programs, installation of instrumentation, monitoring results, and operating parameters and objectives described in the TOMS Manual (among other things) beginning in 2018. The Panel's determination is conclusive.

Since the IRP's Final Report, KP and MR have been implementing the phased site investigation program and expanding the embankment monitoring network while providing on-going updates to the IRP and seeking their input on future objectives. The site investigation and instrumentation plan is routinely upgraded as appropriate to build on information that is collected and to fit overall objectives for both investigation and for monitoring. Planning the annual drilling and instrumentation programs is completed by KP during the first half of each year. KP presents the plan for updates to the monitoring network and planned site investigation methods to the IRP and DEQ each year at an annual update meeting and seeks feedback on the approach and targets from the IRP. Three site investigation and instrumentation programs have been completed since the IRP's Final Report and the reports summarizing the findings have been provided

to the IRP and the DEQ (KP, 2018, 2019a, 2019b). These reports were also provided to ARCO due to their status as the previous owner and operator, and former designer of the YDTI.

Two additional site investigation programs are planned for 2019 and preparation for commencement of these programs is presently underway. The scope of the 2019 site investigations includes the following targets:

- Continued drilling of the embankment and installation of approximately 25 vibrating wire piezometers at up to five new monitoring locations.
- Installation of two inclinometers to monitor for subsurface movement in the maximum embankment section.
- Additional downhole geophysical testing using new innovative techniques within the two new inclinometer casings, which will be installed using a modified drilling and grouting approach in order to improve connection to the formation.
- Seismic cone penetration testing within natural foundation soils in the HsB Area and the historical embankment fill in the basal saturated zone on the lower portion of the embankment.
- Trialing innovative cone penetration testing techniques to determine if in-situ testing can be performed concurrent with sonic drilling in the embankment fill materials during subsequent investigation programs.
- Evaluating percent saturation in borehole samples collected in the variable rockfill materials.

MR and KP will begin implementing a comprehensive movement monitoring program in 2019 now that development of the piezometric monitoring network is well advanced. The movement monitoring program will provide operational monitoring for deformation of the YDTI Embankments, and the program will be continuously refined and updated as part of the on-going dam safety monitoring program. Initially, surface displacements will be monitored using interferometric synthetic aperture radar (inSAR), which provides millimeter precision satellite-based displacement measurements approximately every 12 days. The inSAR measurements will be used in conjunction with terrestrial based movement monitoring technologies such as Global Navigation Satellite System (GNSS) gps-based displacement monitoring and/or mobile laser scanning. Subsurface displacement monitoring from inclinometers will be co-located with surface displacement sites and tied into an overall displacement monitoring analysis.

### 3.2.2 EARLY DETECTION AND MONITORING SYSTEMS

The second component of the proposed Permit Stipulation is termed by ARCO to be *'Early Detection and Monitoring Systems'.* The ARCO letter summarizes the purpose of the stipulation to be to *'implement a robust monitoring program to inspect for, identify, monitor, and provide early warning of embankment slope movement and other indications of potential embankment failure'* and to *'employ best practicable technologies applicable to the operation of tailings storage facilities subject to continuous improvement to assure ongoing adherence with industry best practices'*.

The Montana legislation sufficiently covers the proposed stipulations in both the requirements of the TOMS Manual in MCA 82-4-379 and the requirements of the Design Document in MCA 82-4-376. The following clarifications provide specific examples within the existing State law:

- MCA 82-4-379(3)(e) requires that the TOMS Manual contains 'an identification of all inspections and monitoring and the frequency of inspections and monitoring to ensure the tailing storage facility is performing as intended;'

- MCA 82-4-379(3)(j) requires 'an identification of specific trigger levels or events when the department the engineer or record are immediately notified' and that 'trigger levels must be sufficiently conservative to allow time for corrective actions to be implemented;'
- MCA 82-4-379(4)(b) requires that 'the inspections and monitoring described in the TOMS Manual are reasonably sufficient to ensure the TSF will perform as intended and will reasonably be expected to detect deviations if they occur;'
- MCA82-4-376(2)(e) requires that 'the tailings storage facility will be designed, operated, monitored, and closed using the most applicable, appropriate, and current technologies and techniques practicable given site specific conditions and concerns'

The ARCO Permit Stipulation also suggests that a document termed an *'Early Detection and Warning Systems Plan'* should be prepared for review and approval by the DEQ and IRP describing monitoring and early warning technologies considered and the proposed methods for implementing these technologies. They also suggest that every year an *'Annual Update Report'* should be prepared summarizing the monitoring data and analysis along with detailed monitoring plans for the next year. The suggested documents are similarly already required by the legislation.

1. **Tailings Operations Monitoring and Surveillance Manual (TOMS Manual)** as required in MCA 82-4-379. The TOMS Manual, as previously noted, contains the inspection and monitoring plan for the impoundment and is reviewed annually as per State law and updated as required. The inspections and monitoring described must be sufficient to ensure that the facility is performing as intended and to detect deviations if they occur. The TOMS Manual is also required to contain an **Emergency Preparedness and Response Plan (EPRP)** based on an FMEA or other detailed risk assessment. The EPRP must describe reasonable measures that can be taken to protect human health and the environment. The *'Early Detection and Warning Systems Plan'* is redundant based on the reporting procedures described above that are currently being implemented in accordance with the legislation.
2. An **Emergency Action Plan (EAP)** has also been developed based on a study of the potential consequences of a hypothetical breach of the YDTI (i.e. the "Inundation Study" referenced by ARCO), which is consistent with best practices.
3. **EOR Annual Inspection Report (AIR)** and the associated **Corrective Action Plan (CAP)** as required in MCA 82-4-381. These two documents are supplemented by an annual **Data Analysis Report (DAR)** prepared by the EOR for the YDTI that summarizes the performance monitoring and instrumentation data for the impoundment on an annual basis. The *'Annual Update Report'* is redundant based on the reporting procedures described above that are currently being implemented in accordance with the legislation.

## 3.3 ARCO COMMENTS

### 3.3.1 ARCO COMMENT 1

"*DEQ should require, as a stipulation in MR's amended operating permits for the YDTI, the design and implementation of a data collection, monitoring, and early warning program employing best practicable technologies to: (i) assure that the long-term stability and integrity of the YDTI is maintained…(ii)…, and (iii) ensure that the public health and the environment are adequately protected in the unlikely event of an embankment failure and uncontrolled release of impounded water and tailings.*"

The redundant nature of the proposed ARCO Permit Stipulation was discussed in the previous section and only new aspects to the discussion requiring clarification by the EOR will be addressed below. Under the

sub-heading of '*Current Monitoring*' ARCO quotes some of the relevant stipulations from MCA 82-4-375 and 376 that relate to these statutory requirements. ARCO suggests that '*under this scheme, MR's monitoring program is not consolidated into its operating permit or another document that DEQ can easily administer or enforce'* and they infer *'that under this system, important monitoring data and information may not be reported to either the EOR or to DEQ (neither are present at the mine site) in time to allow them to consider or require corrective measures, if any are needed'*. ARCO has provided similar suggestions and comments relating to the use of best practicable technologies for data collection, and monitoring of the TSF under sub-headings labeled '*Permit Stipulation*', '*Stability Identified as a Primary Concern'*,

The monitoring program is consolidated in the TOMS Manual, and prepared and updated in accordance with MCA 82-4-379. The TOMS Manual is a requirement of the operating permit as indicated in MCA 82-4-335. The EOR is required to certify the TOMS Manual by seal to confirm that (a) the TOMS Manual is consistent with the facility's design; (b) the inspections and monitoring described in the TOMS Manual are reasonably sufficient to ensure the TSF will perform as intended and will reasonably be expected to detect deviations if they occur; and (c) the EPRP describes reasonable measures that can be taken to protect human health and the environment.

An Annual Inspection of the YDTI and associated systems is also conducted by the EOR as described in MCA 82-4-381, and a report is prepared per State law that provides recommendations for refinements to operating practices and monitoring protocols. MR is required by State law to prepare a CAP and schedule for implementation of the recommendations, which is reviewed and verified by the EOR. As described in MCA 82-4-381(5), failure to implement the CAP and schedule, or material deviations from the approved Design Document or TOMS Manual are subject to enforcement provisions of MCA 82-4-361 and 362. The same structure is incorporated in MCA 82-4-380 related to the Periodic Review by the IRP, and failure to implement the CAP associated with this review would be subject to these same enforcement provisions.

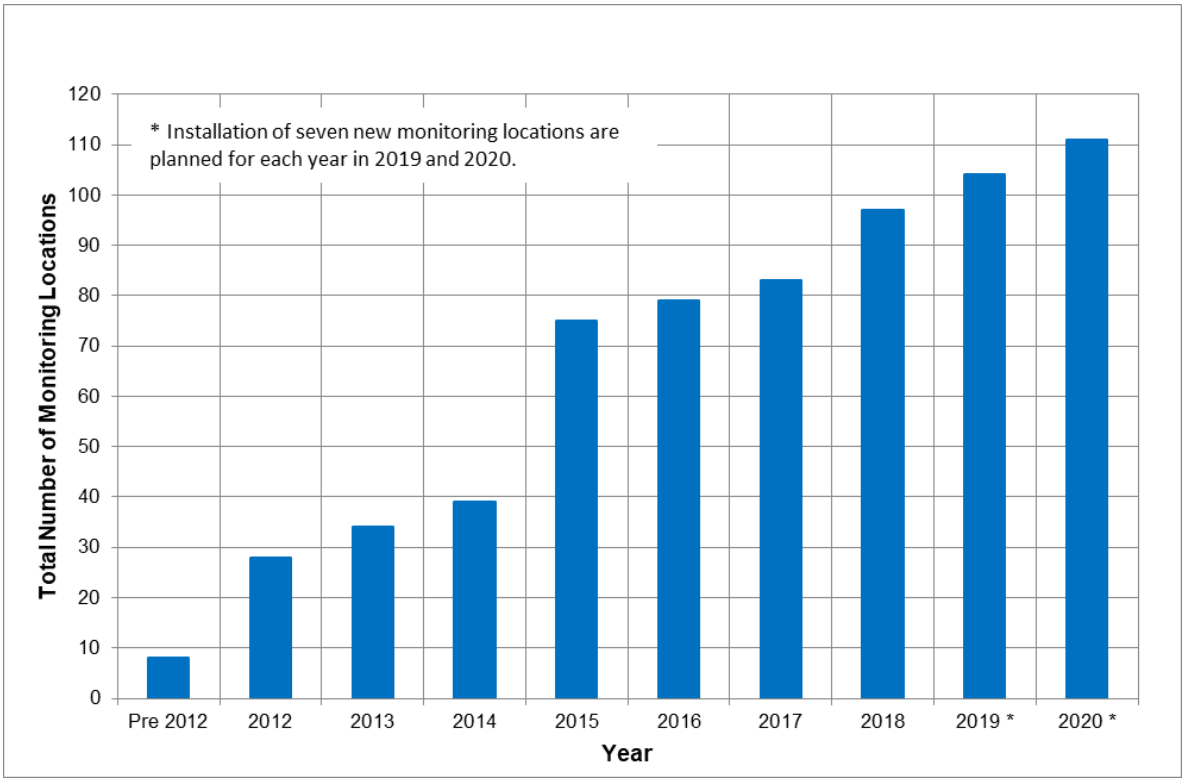
ARCO has also inferred that important monitoring data and information may not be reported to the EOR under the present system and monitoring plan. However, MR implemented and commissioned a web-based remote monitoring system (RMS) for the YDTI in 2018 as a result of a recommendation by the EOR in the 2017 Annual Inspection Report (KP, 2018d). The system allows real-time access to the piezometric data from monitoring sites via a radio and cellular mesh telemetry network. A subset of the instruments have been assigned trigger levels (thresholds) with automatic notification to KP and MR of changing conditions. KP and MR review the thresholds for automatic notification as part of the annual review of the TOMS Manual.

KP and MR have full real-time access to the system to verify that the monitoring data is consistent with expected trends. The project team reviews the status of instruments assigned with trigger levels as part of a weekly meeting. KP provides a formal review of the monitoring data and the trends at the YDTI on a quarterly basis and also prepares a comprehensive annual Data Analysis Report that presents the data and trends for all site monitoring data. These reports are released to the IRP and DEQ for review on an on-going basis. Monitoring systems and protocols are being progressively updated to take advantage of the automation capabilities of the RMS as part of the on-going dam safety monitoring program. These reports and associated recommendations have previously been provided to ARCO; however, as described previously it is unclear what documents have been reviewed by ARCO and/or provided to their technical consultants.

ARCO's inference that the embankment stability and the current monitoring systems at the YDTI are inadequate and inconsistent with the legislated requirements, as outlined in MCA 82-4-375 and 376, is

incorrect. It seems that ARCO and their retained technical consultants are unaware or unfamiliar with the data collection, real-time monitoring and warning systems that are currently in operation and the plans for the progressive upgrading, modification and expansion of the monitoring systems as part of the continuous improvement processes that are being implemented at the YDTI. Figure 1 provides a summary of the number of piezometric monitoring locations added since 2012. Most of the monitoring locations installed since 2015 are outfitted with nested piezometer installations, and approximately 225 monitoring instruments at over 100 sites are providing real-time data through the RMS. All new piezometric monitoring sites, beginning in 2018, are integrated directly with the RMS during installation.

**Figure 1 Number of YDTI Instrumentation and Monitoring Locations since 2012**




ARCO references several sections of the DEIS related to discussion of embankment stability and geotechnical objectives of the impoundment under the sub-heading of *'Stability Evaluation and Assumptions'*. The DEIS paraphrases aspects of KP's Stability Assessment Report (KP, 2018b) and Dam Breach Risk Assessment (KP, 2018c), which were included in the Design Document and subject to the IRP review as described previously. The ARCO comments have subsequently paraphrased and reorganized the content of the DEIS, which has a net result of the 'takeaways' and 'needs' being presented out of context. The following statements from the referenced KP reports are offered as direct clarification of more accurate phrasing of those sections of the DEIS referenced by ARCO and should be considered when updating the DEIS:

- DEIS 3-21, paragraph 5: The key performance factors for stability of the embankment are developing large drained tailings beaches that maintain the supernatant pond remote from the embankments and reduces the pore pressures in the tailings beach adjacent to the upstream face of the embankments in the long-term. Selective and strategic placement of rockfill to support reclamation objectives and to

further improve embankment stability should be considered in the future while evaluating options for storage of excess rockfill produced during mining (KP, 2018b).

- DEIS 4-5, paragraph 1: '*Under the Proposed Action, the YDTI embankments would be raised 50 ft and a North RDS would be added to the downstream side of the North-South Embankment.'* The buttressing effects provided by the North RDS were conservatively ignored in the stability assessment. The estimated factor of safety values resulting from increasing the embankment height were well above the legislated requirements of 1.5 for normal operating conditions and 1.2 for post-earthquake conditions, *as shown on* (DEIS) *Figure 4.2-1*. A factor of safety of 1.2 was also achieved for an extreme sensitivity analysis using undrained strength analysis for the saturated embankment fill and underlying overburden (KP, 2018b). '*Therefore, there would be no cumulative adverse effects related to geotechnical engineering from the Proposed Action.'*

As pointed out in the ARCO letter, DEIS 2-13 paragraph 6 refers to the historical practice of inundating the tailings beach with water to manage wind blown dust. MR's Air Quality Permit requires that the tailings beach "must be maintained wet to the greatest extent possible" for dust control management, which led MR to actively develop a larger pond volume between 2013 and 2015 using make-up water from Silver Lake. The EOR recommended in the 2015 Annual Inspection Report (KP, 2016g)) that MR eliminate this practice and implement multiple tailings discharge locations around the embankment perimeter and use selective discharge to comply with the air quality permit without relying on pond inundation. MR proactively reduced freshwater make-up from Silver Lake in April 2016 to the minimum rate required for processing and further reduced freshwater make-up water requirements again in 2017. The 2015 Corrective Action Plan was prepared following the 2015 AIR and the multiple discharge point system was fully implemented in 2017. The practice of inundating the tailings beach with water <u>was phased out in 2016</u> to achieve the geotechnical objectives for beach development, enhance embankment stability, and limit the potential for internal erosion, and the DEIS could be adjusted to indicate that this is no longer an operational practice.

The ARCO letter also refers to the North RDS as a *'buttress'* and discusses *'the management of the embankment slopes and top width'* as *'corrective measures'* that need to be required somehow in MR's operating permit. As noted above, the buttressing effect of the North RDS is not a design requirement. The embankment slopes and crest width are existing design requirements that are listed in the TOMS Manual and are also future requirements listed in the Design Document that has been prepared by the EOR and accepted by the IRP, and therefore are already requirements of MR's operating permit.

The sub-heading of *'<u>Inundation Risk</u>'* discusses a study of the potential consequences of a hypothetical breach of the YDTI (the "Inundation Study) that was issued to support an update to the **Emergency Action Plan (EAP)** and to provide information to emergency responders for emergency planning purposes. The purpose of the EAP is to safeguard the lives of the public as well as site personnel that may be in the path of the runout of a hypothetical breach of the impoundment. The study does not include consideration of the stability of the facility and does not take into consideration the likelihood of it occurring, but rather is only an assessment of the potential consequences of a sudden water driven loss of containment.

The ARCO letter suggests that the Inundation Study *'describes a more severe impact related to embankment breach than presented in MR's permit application Dam Breach Risk Assessment'.* This statement by ARCO is incorrect. The Dam Breach Risk Assessment includes consequences categories described as Minor, Moderate, Major, and Catastrophic. A Major consequence was defined as a breach outflow that is contained within the project area. A breach outflow that may not be contained within the project area and has potential for an off-site impact was defined as a Catastrophic consequence. A conservative assumption that some failure consequences are potentially Catastrophic was made to simplify

the risk analysis for dam safety decision making purposes. Major and Catastrophic consequences were deemed unacceptable. Either consequence requires a very low probability of failure or a very rare probability of the event occurring to manage risk, and in both cases the Design Document required that future updates to the TOMS Manual consider the residual risk associated with the potential for very low likelihood, but very high consequence events (KP, 2018c).

The Inundation Study seems to be framed as new information; however, it is an update of previous inundation studies produced by others and provides additional detail supporting the assessment of the potential consequences of a hypothetical breach as described in the Dam Breach Risk Assessment. We note that a similar study by International Engineering Company, Inc. in 1981 (IECO, 1981) was produced for ARCO as the previous owner and operator of the YDTI.

ARCO also suggests that DEQ should *'require that MR update and expand its emergency response plan…"* and *'require planning, monitoring, and annual reporting of new information…"*. We note that both requests have been proactively addressed by KP and MR with input from the DEQ and IRP through progressive updates to the EAP, TOMS Manual, and the monitoring instrumentation and reporting protocols for the impoundment since 2015. These updates and refinements are actions taken in consideration of the thorough legislation governing the design, operation, and monitoring of TSFs in Montana, and are part of a continuous improvement process that is already well underway at the YDTI.

### 3.3.2 ARCO COMMENT 2

"*DEQ should require diversion structures below the YDTI embankment that are designed to minimize off-site inundation and other potential adverse consequences of an embankment failure scenario by directing potential outflows toward and into the Berkeley Pit and the Continental Pit to the maximum extent practicable."*

The EOR, in conjunction with MR, the IRP and DEQ, will continue to consider appropriate risk mitigation measures for the YDTI. Dam breach modelling, assessment of practicable measures for routing outflows from hypothetical breach scenarios are options that have been and continue to be considered, but it is not yet clear if these will represent the most practicable and best technologies for on-going risk mitigation at the site.

The EOR and IRP have previously provided recommendations for managing the location and volume of the supernatant pond as being the most practicable and the best currently available option for risk mitigation. These pond management measures are in progress and will be further accelerated once impounded water in the YDTI is reduced as the Berkeley Pit Pilot Project is fully implemented.

### 3.3.3 ARCO COMMENT 3

"*Both MR's proposed action and DEQ's preferred alternative will require management and treatment of water released from the YDTI under the BMFOU Consent Decree and CERCLA remedial action. Atlantic Richfield agrees with statements in the DEIS that DEQ lacks authority under the MMRA to impose such requirements."*

The EOR is not familiar with the details of the BMFOU Consent Decree and CERCLA remedial action, and thus we will refrain from commenting on this aspect of the ARCO letter.

### 3.3.4 ARCO COMMENT 4

"*The DEIS fails to analyze and disclose the significance of impacts associated with the geotechnical stability of the YDTI embankment. The DEIS does not analyze or disclose the impacts of an embankment breach and the resulting release of the contents of the YDTI pond. The DEIS also underestimates the risk of geotechnical instability by assuming that current conditions in the YDTI meet risk management design criteria for overtopping and internal piping and erosion."*

The analysis of impacts from the sudden catastrophic failure of a structure is not typically required or included in an EIS analysis. Hypothetical dam breach assessments are used to inform emergency response planning and are typically not included in the impact assessment for a proposed dam project.

ARCO's statement '*that current conditions do not consistently meet the risk management design criteria'* is incorrect. The ARCO letter refers to embankment design criteria that require the operator to *'maintain ≥ 15 feet of elevational difference between tailings discharge and pond'*. We note that the terminology of the DEIS has been modified slightly compared to the referenced KP reports and the ARCO comments have paraphrased portions of the DEIS, leading to the confusion. The design criteria included in the approved Design Document is that freeboard is sufficient to provide storm storage for the Probable Maximum Flood (PMF) with an additional 5 ft of minimum freeboard for wave run-up (KP, 2017b). Pond levels are presently monitored as required by the TOMS Manual and compared with an existing Quantitative Performance Parameter (QPP) for design freeboard of at least 22 ft. There is presently approximately 43 ft of freeboard in the facility. The 15 ft *'design criteria'* comes from the column in Table 3.4-1 of the DEIS (pg. 3-22-23) labelled as Risk Management Design Criteria, which appears to be presenting several Preliminary Quantitative Performance Parameters (QPPs) from the Dam Breach Risk Assessment (KP, 2018c) as design criteria. This appears to have led to confusion and is inconsistent with the Design Document. The Preliminary QPPs were developed in the Dam Breach Risk Assessment for consideration in future updates to the TOMS Manual. The actual QPPs for the YDTI are outlined in the TOMS Manual. Some of the listed Preliminary QPPs have since been modified and adopted as current QPPs in the TOMS Manual.

The intent of the Preliminary QPP of '≥ *15 feet of elevational difference between tailings discharge and pond'* was to describe a potential metric for comparing tailings discharge elevations with the supernatant pond elevation in the future that could be used to quickly assess the approximate storage available for spring runoff and flood inflows on the tailings beach without approaching the embankment (KP, 2018c; Table 4.3: Note 1). The Preliminary QPP was based on a model of future filling of the YDTI. The filling of the impoundment and the associated tailings discharge elevations are monitored as required by the TOMS Manual. The tailings discharge elevations are surveyed weekly and the entire tailings beach is surveyed annually. This monitoring data is included in quarterly and annual reports described previously. The difference between the pond elevation and tailings discharge elevations currently ranges between approximately 11 ft and 17 ft depending on the discharge location. The uniformity of the tailings beach, the available storm storage capacity, and maintenance of beaches along the embankments has progressively improved since implementing the multiple discharge point strategy in 2017. The EOR is pleased with the progress of beach development and the on-going monitoring protocols. The QPPs in the TOMS Manual are reviewed and updated annually, as stipulated in the legislation, and future updates may include a QPP related to this aspect of the monitoring program if it is practicable.

KP recommends that Table 3.4-1 of the DEIS and the supporting summary text be adjusted for consistency with the approved Design Document to avoid confusion. The following references are offered as clarification:

- The column “Risk Management Design Criteria” should be removed from DEIS Table 3.4-1 to be consistent with Table 7.1 from the Dam Breach Risk Assessment (KP, 2018c).
- DEIS 3-23, paragraph 1: Internal erosion and piping of the embankment under normal operating conditions is not a credible failure mode. The tailings beaches limit the potential for internal erosion and piping by controlling the source of water and seepage flow path. The beaches work in conjunction with the free draining embankments to limit pore pressures at the interface between the tailings and embankment and eliminate any substantial phreatic surface from developing in the embankment. The evaluation shows that the risk of internal erosion and piping will increase if the supernatant pond or tailings stream is allowed to approach one of the embankments due to improper beach development or natural flooding. The alluvium facing, wide crest width, and well graded particle size distribution of most of the embankment fill provides some protection in many areas of the embankment. Improving tailings beach uniformity and reducing the normal operating pond volume will decrease the potential for internal erosion and piping under flooded conditions and will further enhance the safety of the facility under normal operating conditions (adjusted from KP, 2018c; Section 7).
- DEIS 3-23, paragraph 2: Overtopping of the embankment is only a credible failure mode for severe flood events and earthquake-induced deformation. The risk of flood-induced overtopping is very low, and is managed by maintaining the design freeboard (currently 22 ft), throughout continued embankment construction up to the final design elevation. The design freeboard is comprised of storm storage freeboard and additional minimum freeboard for wave run-up. The storm storage freeboard is based on the PMF, which is theoretically the largest flood resulting from a combination of the most severe meteorological and hydrologic conditions that could conceivably occur at the project site. A closure spillway will prevent overtopping in the long-term after operations cease. A large earthquake can induce deformations and settlement of the embankment crest, which could reduce impoundment freeboard. The risk of earthquake-induced deformation leading to overtopping is very low. The presence of the long tailings beach with a depth of 50 ft or more of unsaturated tailings, resistant to liquefaction, would preclude an uncontrolled release, even if a large amount of embankment deformation occurred during extreme earthquake events. The pond will continue to shrink in size after closure (due to climatic conditions), the pore pressures will reduce over time and the exposed tailings surface will be capped, further reducing the risk in the long-term. (adjusted from KP, 2018c; Section 7).

## 4.0 SUMMARY

The YDTI has been progressively developed over the past 56 years. The current EOR (Ken Brouwer, PE) was established in 2015, shortly after progressive new tailings legislation was adopted in Montana. The EOR has been assisted by the extensive team of technical specialists at KP, by independent external specialists as appropriate, and by an Independent Review Panel consisting of three internationally renowned experts. Representatives of DEQ have also been available to attend and support the IRP with their reviews. The IRP’s final determinations are conclusive and binding per Montana legislation.

The EOR is pleased with the progress that has been achieved at the YDTI in roughly four years since formally accepting the responsibility. The on-going design, as well as operations, monitoring and surveillance practices continue to progressively evolve, and take advantage of the best practicable new technologies and techniques to enhance dam safety. The EOR will continue to ensure that the YDTI monitoring systems are progressively updated and expanded to facilitate on-going real time monitoring, along with the implementation of practicable surveillance and early warning systems consistent with best practices.

The EOR is pleased with MR's diligent operating practices and their commitment to continual improvements at the YDTI. The EOR is also pleased with the on-going involvement and contributions from the IRP, and the regular communications and interaction with the DEQ.

The proposed ARCO Permit Stipulations are confusing and inconsistent with the current legislation. It is difficult to see how these could facilitate on-going improvements at the YDTI.

KP welcomes more consistent constructive collaboration with technical personnel retained by ARCO and anticipates that more regular communication would be of benefit to the project, particularly in relation to the ongoing field investigations, the evolving systems for real time data acquisition/analyses and for the review and implementation of additional safety monitoring programs at the YDTI.

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Yours truly,
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