‘Top 10’ Facility Decommissioning Risks and Mitigation Strategies to Prevent Them – 16487

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ABSTRACT

Decommissioning represents a set of risks that differ from facility design and construction, operations, or maintenance. An informal poll was taken querying experienced facility decommissioning project and program managers in government and private business sectors about top decommissioning risks. The poll considered experience in nuclear, fossil fuel, and oil and gas projects in Canada, the United States, the United Kingdom, and Australia. A classic risk assessment process was performed, where the likelihood and consequence(s) of impacts, typical or most commonly used controls, and the most effective mitigation strategies for various risks were identified. The risks that polled with the highest rankings were identified as the ‘Top 10’ decommissioning risks.

Roger VanScoy stated “Knowing our risks provides opportunities to manage and improve our chances of success.” The purpose of this effort was to identify and share the ‘Top 10’ decommissioning risks with those in the nuclear, fossil fuel, and oil and gas industry to help anticipate and manage those risks more effectively, avoid or reduce the potential consequences of the risks, and improve the chances of project success.

Douglas Adams said: “Human beings, who are almost unique in having the ability to learn from the experience of others, are also remarkable for their apparent disinclination to do so. “The information provided shares experiences, knowledge, and effective mitigation strategies from those with successful decommissioning experience so that others can learn and avoid the adverse consequences of risks inherent with decommissioning projects.

INTRODUCTION

Decommissioning presents a significant change in hazards and processes from facility design and construction, operations, or maintenance, and introduces a different set of risks. An informal poll of project and program managers and technical consultants with significant successful experience on decommissioning projects in nuclear, fossil fuel, and oil and gas industries, identified the ‘Top 10’ decommissioning risks as:

1. Poorly defined project scope of work/client contract which leads to interpretation issues and additional work and costs.
2. Inadequate initial characterization results in changes to work plans and increased cost and waste volumes.
3. Scope creep and unauthorized scope changes result in additional costs and schedule delays.

4. Regulatory buy-in for the end state or approach.
5. Contamination levels higher than expected causing additional controls, schedule delays, and additional waste.
6. Customer expectations and oversight results in work slow-down/stoppage and/or additional scope requests.
7. Estimates are not accurate and higher actual costs are realized.
8. Productivity loss from weather, logistics, or unanticipated radiological work results in additional costs and schedule delays.
9. Experienced resources are not available to perform project planning or execution.
10. Lack of or inadequate facility or site historical data leads to incorrect assumptions and increased scope.

These risks were further categorized into scope, performance, financial, stakeholder, and environmental risks. Based on experience, these top 10 risks were identified as the most likely to occur of all those identified, or have occurred most frequently on decommissioning projects. The consequences of the top 10 risks, the typical controls that can be used, and effective risk mitigation strategies are discussed in further detail.

DISCUSSION

Risk Assessment Process

An informal poll was taken among experienced facility decommissioning project and program managers in the government and private business sectors with successful experience in nuclear, fossil fuel, and oil and gas markets within Canada, the United States, the United Kingdom, and Australia. Each person independently identified 5 to 10 of the top risks that they felt had the highest likelihood and consequences for decommissioning projects. For each of the risks that were identified the following information was recorded: likelihood and consequences (before and after controls and mitigation strategies are implemented), typical controls, and the most effective mitigation strategies and techniques. All of the identified risks were then ranked, and the ‘Top 10’ decommissioning risks were selected. Risks were also categorized into three business sectors, nuclear, fossil fuel, and oil and gas, to determine if they were applicable to all or if the risk levels change in these differing industries.

Interestingly, a majority of the risks identified for decommissioning projects in one industry were also identified as being in the ‘Top 10’ decommissioning risks for the other industries, with the only exceptions being for risks that inherently don’t exist in specific plants (e.g. radiological release typically only exists as a risk for nuclear decommissioning projects [naturally occurring radioactive materials (NORM), although present at fossil fuel and oil and gas decommissioning projects, is typically not present in sufficient quantities or levels to create significant release]).

Risk 10, Lack of or Inadequate Historical Data

Sites or facilities that are designated to be decommissioned are often aged with an extended operating history. When the site or plant history is not known or well-documented, the full scope of decommissioning may not be well-defined. This can lead to incorrect assumptions and requirements for additional work. This risk can be controlled by identifying all of the assumptions in detail as a part of contracting. Aldous Huxley said: “There are things known and there are things unknown, and in between are the doors of perception.”

For decommissioning, the risk of the unknown is more than a perceived risk. Additional mitigation measures for inadequate historical data include:

- Seek to identify records and interview former long-term employees to understand and document historical insights.
- Clearly document specific exceptions and assumptions.
- When conditions vary from expectations, pause the work to modify plans and gain approval of the resulting changes to planning.
- Implement rigorous change management.

Risk 9, Experienced Resources not Available

Decommissioning projects require some special skills for adequate project planning and execution, and people with the skills and project experience for successful decommissioning are not plentiful. Naveen Jain stated: “Success doesn’t necessarily come from breakthrough innovation but from flawless execution. A great strategy alone won’t win a game or a battle; the win comes from basic block and tackling.” Similarly, the most successful decommissioning projects rely on early and near flawless planning and a staff that is available and invested in executing (and when necessary changing) the plan.

Early resource planning is an obvious control for this decommissioning risk. Recommended mitigation of the risk is to identify resources and solicit commitments for the qualified and experienced resources needed for the project. Edward Lampert said: “The entrance strategy is actually more important than the exit strategy.” Using skilled resources to plan and execute the decommissioning project is a winning entrance strategy.

Risk 8, Productivity Losses

Initial project cost estimates are based on an expected level of productivity. The actual productivity may be relatively high if the site/facility is not in a secured area and if many of the hazards have already been removed, or may be relatively low if the site is a nuclear site or where a high level of training and briefings are required. In addition, productivity loss can occur from weather delays, high/low temperatures, logistics (in-processing, screening of equipment, and equipment production rates), or required monitoring and analysis.

Negative changes in productivity against those estimated will increase costs and cause schedule delays and must be aggressively managed. It may even require work stoppages to reassess the work methodology and to come up with

alternative approaches. This may require trial and error methods, with additional time.

When dismantling large above ground structures, various health and safety legislations forbid working at heights when wind speeds are above a certain threshold. Sometimes referred to colloquially as being “winded off”, this weather condition often results in numerous lost days. Similarly, adverse weather conditions relating to temperature and precipitation, including snow and ice, will also significantly impact site based activities. In extreme circumstances weather conditions may affect the contractor’s ability to travel to the work site.

It’s important that weather risk is understood by all parties, including the likely hazards and the likelihood of impacts. All parties should familiarise themselves with historical meteorological conditions. It is important that weather related risk is properly apportioned in the decommissioning contract and schedule whether of a lump sum or reimbursable nature. Where weather risk is held by the contractor, they should allow sufficient contingency in their prices, and also state the risk allowance. Both of these items should be communicated to the client at the tender stage. The client should satisfy themselves that the contractor has made adequate provisions. Where the risk is held by the client, they should make adequate financial provision for weather risk beforehand and agree to possible fee variations with the contractor. Similarly, the contractor should represent adequate float in their schedule to allow for weather risk which should not be drawn down without the agreement of both parties.

Typical controls for productivity delays are to put float into the project schedule, including an allowance for lost work days, and mobilize early to the site. Dr. Michael Ong stated: “Good risk management fosters vigilance in times of calm and instils discipline in times of crisis.” This is where risk management meets project planning, cost estimating, and scheduling as integration of these aspects is needed to account for productivity increases or decreases. Additional mitigation techniques include:

- Define productivity impacts for change orders or reimbursement.
- Include standby costs and conditions in the contract.
- Accelerate work hours and days in those weeks and months where weather related impacts are less likely.
- Save inside facility work for weather affected days or periods of low productivity outside.
- Schedule radiological technicians to work extended hours or offset shifts for monitoring and readiness activities that supports work crews before and after normal work hours.
- Use real-time radiological monitoring.
- Include radiological work assessments for each activity above a pre-established threshold.

Warren Buffet stated: “…the rear view mirror is always clearer than the windshield.” These lessons from past decommissioning projects that had productivity decreases can and should be applied to current and future decommissioning projects.

Risk 7, Cost Estimates are Too Low

Estimating decommissioning projects can be challenging as little public information exists on decommissioning norms, project benchmarks, or unit rates for decommissioning activities. In addition, with the unique complexities of each decommissioning project, it is often difficult to place significant confidence in any available published activity unit rates as they may not be applicable, may be old or out of date. In addition, much data that that can be found may be proprietary to another company, or be parametrically derived from a previous decommissioning project's actual production rates that may not have been specifically captured.

Many decommissioning projects are now being bid as lump sum projects, which represent a higher risk to contractors. If cost estimates are not accurate, significant financial loss may result. If technical assumptions are not adequately identified, then changes in conditions or scope may also be very costly. Typical controls include:

- Develop cost estimates with Subject Matter Experts (SMEs).
- Use activity-based cost estimating methods.
- Benchmark with like or similar projects or activities.
- Use internal and independent technical and quality reviews.
- Tightly bind and document the scope and assumptions in the basis of estimate (BOE).

Additional mitigation techniques include:

- Use a risk allowance, based on likelihood and consequence.
- Include contingency costs – with expectations that they will be spent.
- Use appropriate change management.
- Use an experienced Project Manager with lump sum project experience.
- Use independent SME reviews of the estimate.

Charles Tremper said: "First step in the risk management process is to acknowledge the reality of risk. Denial is a common tactic that substitutes deliberate ignorance for thoughtful planning." The project team needs to acknowledge that the risks exist. By doing this, the team will worry about the risks and identify ways to address or mitigate them. When this is done proactively during project planning, the project team will be ready for when the risks occur. If the risks don't occur, that's fine; the risk planning effort was still worthwhile.

Risk 6, Managing Customer Expectations

Stakeholders are critical in understanding and defining success. They typically have a number of objectives that need to be met. Some objectives are clearly communicated; other expectations are not readily communicated or may be left unstated. The unstated expectations are often equally important as those that are clearly communicated. To ensure that these objectives and expectations are met, customers and other stakeholders may require or provide oversight for the duration of the project or just for specific phases. Successful projects strive for the fine balance to inform, but not over-inform, and to involve stakeholders, but

not to the point that they are managing the project. Stakeholders each have different backgrounds and different passions. Therefore, each must be understood, kept informed, and involved throughout the project. Generally, the more involved and more informed, the better the relationship with the customer and stakeholders.

Not managing or informing customers and stakeholders at the appropriate level can have numerous and varied levels of impacts. These impacts may range from: frustration, minor reputational impacts, temporary loss of trust or confidence, and/or minor communication issues to significant work productivity reductions, work stoppages, lack of payment, numerous meetings with executive management, potential for site infractions, or loss of the contract. Typical controls include:

- Develop and comply with detailed work plans or work packages.
- Align work with the project health, safety, and environmental (HSE) policies and programs.
- Include detailed technical scopes of work in Requests for Proposals.
- Define alignment requirements in the terms and conditions of the contract.

Theodore Roosevelt stated: “Risk is like fire: if controlled, it will help you; if uncontrolled, it will rise up and destroy you.” Customer and stakeholder expectations and communications need to be actively managed. If not managed, many difficulties can arise, up to and including contract cancellation.

Effective risk mitigation techniques include:

- Use early alignment workshops to identify key/energized/passionate stakeholders and the success factors, criteria, and concerns of each.
- Educate customers/stakeholders of key technical challenges and proposed methodologies.
- Involve customers or stakeholders in reviews of overall work plans and approvals.
- Use an active and formal comment resolution and disposition process.
- Seek early concurrence with outlines and levels of reporting detail.
- Early definition and concurrence of what is in and out of scope.
- Use documented and agreed endpoints.

George Santayana said: “Those who cannot remember the past, are doomed to repeat it.” Many have gone down this road before and have experienced unanticipated or unrealistic customer/stakeholder expectations, have dealt with a high level of oversight from customers and stakeholders, and/or have been able to utilize these strategies effectively to manage customer and stakeholders for joint success. Sharing these experiences will help to ensure techniques or practices that didn’t work aren’t repeated.

Risk 5, Contamination Levels Higher than Expected

Radiological or non-radiological (i.e. hazardous materials) contamination is typically sampled, measured, surveyed, and assessed as part of the project planning; however, there are often areas that are initially inaccessible, may be

shielded by other structures or equipment, or may be released once overlying coverings, sealants, or barriers are removed. Unfortunately, despite numerous surveys and assessments, higher contamination level surprises occur on almost every decommissioning project.

Higher contamination levels will require additional engineering and administrative controls such as barriers, ventilation, upgraded protective equipment or enhanced respiratory protection, time limits for exposure, or other controls that will impact the time to perform decontamination and removal. These requirements will result in increased costs, productivity loss, and schedule delays. Additionally, increased waste volumes will be expected.

Typical controls include historic assessments, early characterization (intrusive if required), full radiological surveys, and onsite or point source radiological monitoring. Gary Cohn stated: “If you don’t invest in risk management, it doesn’t matter what business you’re in. It is a risky business.” Decontamination and decommissioning work is inherently risky business. Project teams must exercise proper risk management, by taking early mitigation actions, particularly where the work is already more hazardous, to reduce the likelihood and consequences of the risk being realized.

Risk mitigation techniques include:

- Intrusive characterization sampling and surveys.
- In Situ Object Counting System (ISOCS) surveys for isotopic identification.
- Radiological work permits for varying levels of contamination.
- Back-up equipment onsite and ready to be used.

Randy Paush said: “One thing that makes it possible to be an optimist is if you have a contingency plan for when all hell breaks loose.” Project teams often plan and estimate to have higher levels of productivity in order to be the lowest cost. They rely on the information provided and don’t plan for higher levels of contamination. When the risk of higher contamination occurs, they are surprised and not ready. If the project planners prepare for higher levels of contamination, and have the work plans and equipment ready to use when these higher levels are reached, work can be briefly paused until a new Job Hazard Analysis can be prepared and work can resume.

Risk 4, Regulatory Buy-In

Regulatory approval of the closure, remediation, or decommissioning plan, final waste disposition, and end-state is often the critical path for decommissioning projects and makes the difference between successful delivery and failure. The consequences of delayed regulatory approvals include delays or inability to gain concurrence or buy-in for the end-state. This may require significant additional studies, workshops, review sessions, business cases, or alternative selection studies, which will all result in additional cost and schedule delays.

Typical controls include: effective stakeholder management, early discussions with regulators, seeking formal approval of closure or remedial action plans prior to beginning the project, and demonstration that the closure criteria are met via

end-points, sampling, or confirmation surveys. Peter Senge stated: “The easy way out usually leads back in.” If project teams don’t take the time to finalize the end-state upfront, then they will end up going back to try and negotiate the end-state at the end or do more at the end to achieve it. Mitigation techniques for this risk include:

- Use early identification of endpoints for regulatory approval.
- Document the scope of work in the approved closure plan.
- Use ongoing stakeholder communication and reporting throughout the project.

H. Felix Kloman said: “One cannot take risk management too seriously.” Regulatory approval is a key to achieving project success; therefore, the project team should take these approvals quite seriously.

Risk 3, Scope Creep and Unauthorized Changes

Scope creep is one of the most common risks to any project, and a decommissioning project is no exception. Even if the scope is well-defined, as conditions change and new information is found or emerges there may be customer pressure to do a little more here and there, or there may be pressure that those additions were generally part of the original scope of work or were included under a general description of the activities.

Scope creep causes cost increases and schedule delays. These changes may also create additional technical, safety or environmental liability, known or unknown. Unauthorized changes can also jeopardize the completion of the deliverables and achievement of the approved end-state. Typical controls include providing variation reports and change orders with consistent contract management. Warren Buffet stated: “Risk comes from not knowing what you are doing.” Therefore, the better the project team defines, captures, and documents what will be performed, the likelihood of scope creep will be decreased and/or the impact or consequence of scope creep will be reduced. Additional mitigation techniques include:

- Use detailed scoping with endpoints for each project, area, and space system.
- Document the technical basis and assumptions.
- Use a dedicated contract/change manager while the project manager is focused on managing the project to ensure delivery.
- Communicate early about potential impacts or changes in scope.
- Monitor for scope creep.
- Develop, seek approval, and implement a detailed communications plan.

Niccolò Machiavelli said: “All courses of action are risky, so prudence is not in avoiding danger (it’s impossible), but calculating risk and acting decisively. Make mistakes of ambition and not mistakes of sloth. Develop the strength to do bold things, not the strength to suffer.” The project team must take early action to define the scope clearly, define the risk, and take the appropriate actions. Successfully executing challenging projects requires that the project team be prepared to handle change and risk through appropriate mitigation strategies, when changes happen.

Risk 2, Inadequate Initial Characterization

Over time, site and process knowledge is sometimes lost or not properly documented. This often makes understanding the current condition of the facility or plant very difficult. Inadequate characterization is more common in facilities that have been abandoned, mothballed, or shutdown with little warning and with limited or no continued care, surveillance/inspection, or maintenance. Generally in these cases, operations staff have dispersed or are otherwise not available to fill in some of the gaps.

Site-based constraints, when identified late and not dealt with properly in the decommissioning contract can lead to delays and increased costs, and in extreme circumstances can also lead to contractor disputes. Examples of this are where protected species are identified during demolition, or where unknown hazardous utilities, such as high pressure gas mains, are encountered during excavation. In the case of protected species, mitigation measures can be put in place if pre-demolition surveys are adequate and timely. Species can generally be relocated, but often only during certain periods of the year outside of nesting and breeding seasons. Inadequate planning may delay the project by up to six months. Undocumented utilities can be encountered during excavation activities if relying completely on as-built drawings; as noted earlier, configuration control documents and drawings can be lost, wrong or outdated, hence it is advisable to always confirm drawings via field verification through pot-holing, utility surveys, and zero-energy checks if identified and there is a need to breach the line.

Not having a current and accurate assessment of the facility/plant condition or not performing adequate characterization for safety, work methodology, or waste disposal considerations will create an incorrect planning basis that will ultimately require revisions, rework, and changes during the performance of the work. These changes will also lead to work stoppages, increased waste volumes, and increased costs. Typical controls include: capturing site, facility, and process/historical knowledge during or at the end of operations, just prior to beginning deactivation or decommissioning, and performance of biased (targeted) characterization studies for areas that are less well-understood. Control can also include documenting the assumptions based on known conditions. Machiavelli stated: “Wise men say, and not without reason, that whoever wished to foresee the future, might consult the past.” It is well advised not to ignore the past, rather seek to capture it, review it, and understand it. Additional mitigation techniques include:

- Complete full characterization of low confidence areas (intrusive or non-intrusive) using advanced scanning and analysis technologies and sampling and visual confirmation as appropriate.
- Perform confirmation surveys to verify current conditions to the satisfaction of technical and management stakeholders.
- Perform historic assessments and document the facility condition at the end of operations, where possible.
- Develop contingency plans and work methodologies where conditions are unknown due to inaccessibility or high cost to obtain additional information.

- Include step-up and step-down criteria in work planning and execution documentation, based on survey/sample results to minimize work stoppages.

Lee Iacocca said: “Even a correct decision is wrong when it was taken too late.” Project teams should strive to make the appropriate early decisions to understand the site such that the planning and execution decisions made will be the correct ones.

Risk 1, Poorly Defined Client Scope/Contract

Most owners of closed or mothballed facilities are not experienced in decommissioning – technical and management staff in owner companies are very good at their core business but many believe that decommissioning is a simple process that is learned on the fly. They may have recent successful experience in building, commissioning, and operating new plants and sites, but decommissioning may be a first-of-a-kind for many clients in nearly all markets and is certainly first of a kind for the on-site operations staff. When the client does not adequately understand the scope or the most effective contract terms and conditions for decommissioning work, the scope and/or the contract may be poorly defined with unbalanced risk sharing. Experienced contractors can help their clients minimize this risk, especially when consulted early in the planning process, such that guidance can be provided for both scope and contractual terms that will be deemed mutually beneficial.

This risk presents an opportunity to offer advice and guidance to clients, which may also be a differentiator for experienced consultants, acting in an owners engineer role for instance, and contractors. A skilled and experienced contractor can outline the scope of work that will best suit the client’s needs while still keeping the methods and means for execution proprietary, as they see fit. Draft contract terms can be qualified based on prior successful experience. Rosalynn Carter said: “If you don’t accept failure as a possibility, you don’t set high goals, you don’t branch out, you don’t try – you don’t take the risk.” Project teams can accept the possibility of failure for decommissioning projects and proceed with little or no control, or seek to identify and control risks by putting in place the necessary mitigations to reduce the likelihood and consequences to give the decommissioning project the best chance for success.

CONCLUSION

Is it now your time to take decommissioning risks more seriously, or will you continue to press your luck? Do you know your risks? Will risks control you, or will you control your risks? How much risk are you willing to accept or tolerate? Decommissioning risks can have major and serious consequences. Knowing the risks is not enough. Assessing these risks is not enough. Identifying mitigation strategies and tactics is not enough. Project teams must learn from history and prepare for tomorrow, today. Active and aggressive risk management must be exercised for decommissioning projects, by taking actions to control the risks, rather than waiting for the risks to control the project.

Steve Harvey stated: “Failure is a great teacher, and I think when you make mistakes and you recover from them and you treat them as valuable learning

experiences, then you've got something to share." Hopefully project teams can learn from the cumulative experiences of the contributors of this survey to avoid the most common risks in decommissioning projects.