

ASSESSING AND ADDRESSING INCREASED STAKEHOLDER AND OPERATOR INFORMATION NEEDS IN NUCLEAR FUEL CYCLE FACILITIES: TWO CONCEPTS

DAVID H. SALTIEL

Sandia National Laboratories

P.O. Box 5800, MS-1373, Albuquerque, NM 87109, USA

E-mail : dhsalti@sandia.gov

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Nuclear energy programs around the world increasingly find themselves at the nexus of potentially conflicting demands from both domestic and international stakeholders. On one side, the rapid growth in demand for electricity coupled with the goal of reducing carbon emissions calls for a significant expansion of nuclear energy. On the other, stakeholders are seeking ever greater safety, environmental, security, and nonproliferation assurances before consenting to the construction of new nuclear energy facilities. Satisfying the demand for clean energy supplies will require nuclear energy operators to find new and innovative ways to build confidence among stakeholders. This paper discusses two related concepts which can contribute to meeting the needs of key stakeholders in cost effective and efficient ways. Structured processes and tools for assessing stakeholder needs can build trust and confidence while facilitating the “designing-in” of information collection systems for new facilities to achieve maximum efficiency and effectiveness. Integrated approaches to monitoring facilities and managing the resulting data can provide stakeholders with continued confidence while offering operators additional facility and process information to improve performance.

KEYWORDS : Public Confidence, Nonproliferation, Safeguards, Process Monitoring

1. INTRODUCTION

The democratization of the dialogue about how to meet growing energy needs is pushing energy producers to respond to a host of new demands and expectations. A diverse array of stakeholders have found a voice in energy decisions and are demanding that production be clean, safe, and inexpensive. These demands offer both opportunities and challenges to the nuclear energy industry. On the one hand, the demand for non-carbon emitting technologies plays directly to one of the key advantages of nuclear power. On the other hand, the demand for greater assurances against a range of risks – some of which are properly evaluated, others which are not – poses significant challenges to an industry that has historically been somewhat reluctant to engage directly with stakeholders. This culture of opacity – an unnecessary artifact of the origins of nuclear energy – has hurt the industry both by undermining public confidence and in reducing innovation in the area of information acquisition and management.

It is in the interest of individual operators and the industry as a whole to actively adopt creative approaches

to acquiring and managing information when designing nuclear energy facilities. Stakeholder demands, especially when translated into new national and international regulations and obligations, often impose significant and costly burdens on operators. Innovative approaches to assessing and addressing information needs can not only help reduce these burdens, they can also help rebuild public confidence and trust and improve facility management and operations in cost effective ways.

This paper reviews the main challenges facing nuclear facility operators associated with meeting national and international stakeholder demands and regulatory requirements in a cost effective manner. It then examines two concepts related to the acquisition and management of facility operational information which may help alleviate those challenges. The first, an integrated approach to facility monitoring and data management, seeks to reduce monitoring redundancies and intrusions while acquiring more accurate and timely information, and to provide secure, managed access to the resulting information to multiple stakeholders. The second seeks to bring stakeholders into the design

process of new facilities at a very early stage, to identify information needs and design trustable and efficient approaches to the acquisition of that information. Both provide complementary benefits to the operator in reduced burdens, improved information access, and cost effective implementation.

2. CHALLENGES

Nuclear facility operators are facing increasing demands to prove compliance with laws and other obligations and to demonstrate transparency and good will. These demands manifest themselves in the form of additional monitoring equipment, new facility controls, and inspections. Meanwhile, operators are being pushed to seek improved process efficiencies – a goal which may be aided by additional facility and process information. This suggests there may be ways in which the demands to more closely monitor facilities and process from external stakeholders can be complementary with the needs of operators. By developing a fuller understanding of what information is needed by whom, efficiencies may be sought in monitoring and data management.

2.1 Domestic Challenges

The primary focus of national stakeholders tends to be perceived environmental and safety risks of nuclear energy facilities. More recently, concerns about security have also risen in importance. While the nuclear industry has long argued that these concerns are misinformed, the worry persists due in some measure to insufficient access to credible and trusted information. Acting through the judicial and regulatory systems, national stakeholders have succeeded in blocking the construction of new facilities and creating new regulatory requirements. Nuclear operators find themselves required to provide ever greater quantities of data to national regulators to demonstrate the robustness of their systems and prove that their operations are environmentally benign. Both operators and regulators face increasing workloads to respond to stakeholder needs.

2.2 International Challenges

International stakeholders – including transnational non-governmental organizations (NGOs), intergovernmental organizations and regulators such as the International Atomic Energy Agency (IAEA), and states, are also exercising their voice to shape the development of nuclear energy. These stakeholders share the concerns of national stakeholders but also add (and emphasize) nonproliferation – the concern that a state might misuse its civilian nuclear facilities for military applications. Because of their distance, international stakeholders tend to have less of an ability than national stakeholders to stop nuclear energy projects

outright. However, the most serious concerns of international stakeholders often do find expression in additional oversight and verification obligations which impose significant additional burdens on operators and international inspectors and regulators.

2.3 Operational Challenges

As new and more complex facilities come on line, operators must find ways of maintaining the cost competitiveness of nuclear energy. To do this, improvements must be made in operations and processes – both goals that improved monitoring and data management can facilitate.

2.4 Common Challenges

To resolve concerns and questions about safety, environmental impact, security, and nonproliferation, approaches should be sought which:

- 1) Enhance the ability to effectively engage key stakeholders early in the planning of new facilities;
- 2) Enhance the ability to collect and provide sufficient relevant information in a timely fashion;
- 3) Enhance the ability to make sufficiently accurate measurements;
- 4) Reduce the burden on inspectors and regulators; and
- 5) Reduce the burden on facility operators or even offer the ability to improve efficiencies.

3. INTEGRATED MONITORING AND DATA MANAGEMENT SYSTEMS

The first concept which can contribute to addressing the concerns of stakeholders and operators in mutually beneficial ways is the development of integrated facility and process monitoring approaches which take advantage of, to the greatest extent possible, the operator's data collection tools and which provide a single hub for the management and provision of acquired information.

At present, the general approach to monitoring nuclear facilities has been for operators and regulators to act independently in their monitoring activities. This uncoordinated process of adding sensors and other data collection tools as new needs are discovered, not only results in redundancies but also frequently leaves stakeholders with less information than they would have ideally wanted.

3.1 The Elements of an Integrated Approach

An integrated, efficient, timely, and trusted approach to facility and process monitoring involves six key elements:

- 1) *Assessment* of monitoring needs

- 2) *Acquisition* approaches
- 3) *Aggregation* of multiple, disparate data streams
- 4) *Analysis* of acquired data to draw meaningful, reliable, and transparent conclusions
- 5) *Access* to data and analysis in a secure and managed environment
- 6) *Authentication* and security of acquired data

A first step toward more efficient monitoring approaches is the conduct of a detailed information needs *assessment* (a primary focus of the second concept discussed in this paper) which attempts to understand *what* information is needed by *whom*. From this, an approach can be designed which examines the range of available information and considers how information can be *acquired* in the most efficient and accurate manner with the least interruption of facility processes and activities and the least burden on operators or regulators. In some cases, this will require additional sensors and data collection tools, but more often, it will involve an approach to data integration which draws substantially on existing, operator-owned monitoring tools.

A key step in this integrated approach is the development of a secure, flexible, central data repository which would facilitate the *aggregation* of multiple data streams to evaluate and conduct *analysis* related to specific areas of interest. In addition to being a central collection point for data inputs, the data repository would be a central distribution point from which secure and managed *access* to particular data streams could be facilitated (Fig. 1). For example, a domestic environmental oversight group might have access only to information pertinent to its concerns while a neighboring state might have access

only to that information which built confidence that the facility was not being misused. Developing approaches to reliably provide appropriate parties access to specific information streams while simultaneously preventing access to other information streams, is a critical element in the design of these data repositories.

The uncoordinated, independent, single purpose sensor approach to monitoring has often been done to ensure that data acquired can be trusted – that the data originated from the intended source, that it was not changed in transit, and that it is not a repeat or delayed copy of previous data. This critical need must not be overlooked in the quest for efficiency, but can be accommodated through the application of data *authentication* and security approaches “designed in” to monitoring equipment and information transmission mechanisms.

3.2 Benefits of an Integrated Approach

Because it offers the ability to access and use more, more accurate, and more timely data with fewer facility or process intrusions, an integrated monitoring approach presents potential benefits in at least three areas. First, by accessing a greater range of data and seeking synergies among those data streams, an integrated approach offers enhanced observation capabilities. The possibility exists to make more accurate measurements more frequently (in some cases continuously) than existing approaches allow. This aids both internal (operators) and external stakeholders.

Second, an integrated approach offers operators improved flexibility in providing stakeholders with

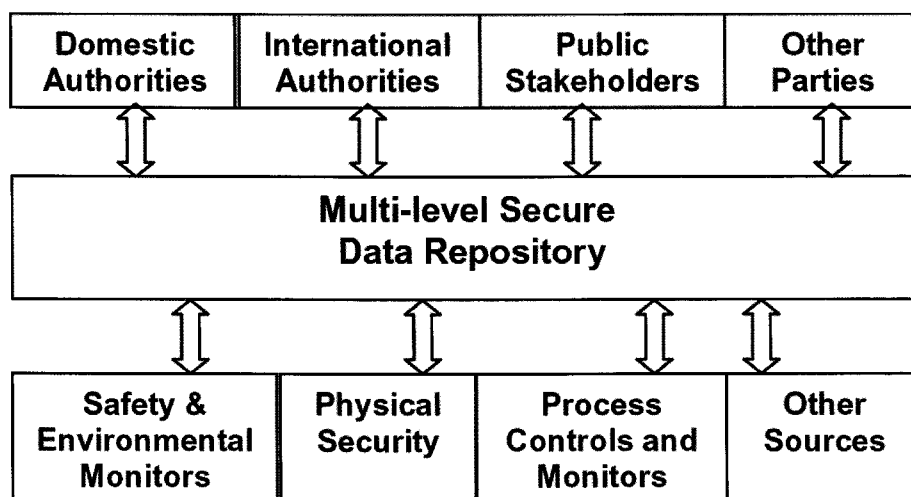


Fig. 1. An Example of a Multilevel Secure Data Repository

managed access to information without endangering proprietary or security information. For example, an agreement between operators and stakeholders may be reached whereby stakeholders are informed about normal facility operating parameters. Stakeholders and operators might then jointly develop an analytic process to identify anomalies of a certain degree. Stakeholders would then be allowed to monitor only the signal indicating whether an anomaly has occurred. This “check engine light” approach to transparency gives stakeholders additional information and places a burden on operators to explain anomalies while not revealing sensitive or proprietary information.

Finally, an integrated approach may help to reduce the burden of externally imposed monitoring requirements on both inspectors and operators. Operational needs and national regulations will require facility operators to invest in complex control systems. The addition of authentication and data management tools to allow for the greater use of operator-owned equipment in gathering and transmitting information for external stakeholders offers the prospect of limiting added sensors, thereby reducing the burden on operators and the cost to regulators and inspectors. This is particularly important for the IAEA which faces a growing mission and mandate without a concurrent increase in resources. In the absence of improved monitoring efficiencies, stakeholders may begin to lose confidence in the Agency’s ability to support the nonproliferation regime.

3.3 Limitations and Cautions

As noted above, to be useful in meeting the needs of any external stakeholder, facility and process data must be authenticated at the source and protected throughout transmission. This is a particularly critical challenge with regard to finding ways to support the mission of the IAEA. During its most recent review of policies related to the joint use of data acquisition equipment, the IAEA moved further away from integrated monitoring approaches citing concerns about the degree to which information acquired by the facility operator can be trusted and whether the use of this data might undermine the independence of the Agency’s conclusions.¹ The same concerns about authenticity of information apply to the voluntary provision of information to external stakeholders. If there is any question as to the integrity of the provided information, the effect will be to undermine public confidence and trust.

There is also a very real risk that in gathering and providing more information to meet the demands of stakeholders, operators and their regulators will provide too much information and create security vulnerabilities. For example, information on fuel reloading schedules at a reactor might be valuable in demonstrating burn-up levels consistent with commercial spent fuel rather than plutonium production, but may also communicate fresh

or spent fuel transportation schedules and thus increase the risk of theft or sabotage. Careful thought must be given to balancing the requirements of oversight organizations and the reasonable requests of stakeholders against the need to protect sensitive and proprietary information.

Finally, given the complexities associated with advanced nuclear facilities, meeting the demands of stakeholders for information will, in some cases, require the provision of analysis rather than the provision of raw data which may or may not be properly evaluated. Here again, a balance must be struck between providing meaningful information and providing trustable information. Analytical methods themselves will likely need to be the subject of negotiations between operators and stakeholders and analytic techniques that are either hidden or are overly complex may tend to be mistrusted.

Approaches to ensuring the authenticity of data, protecting sensitive information, and providing meaningful information can be developed, but they will tend to negatively impact the efficiency gains discussed above.

4. MODELING APPROACHES TO ASSESS NEEDS AND IMPROVE INTEGRATION

The second concept considered here focuses on a formal approach to engaging stakeholders to assess information needs and designing-in the integrated monitoring approach discussed above to ensure maximum efficiency and effectiveness.

4.1 A Formal Process for Assessing Information Needs

As noted above, critical to developing an integrated monitoring approach is properly assessing the full spectrum of stakeholder information interests. Typically this has been done informally or not at all. Creating a formal process for engaging stakeholders can not only help to ensure that the needs assessment process is efficient and complete, it can also contribute substantially to building stakeholder trust by creating an environment of sharing at the earliest stages of facility design.

Modeling and visualization tools have frequently been used by nuclear facility owners and operators to educate stakeholders about existing and proposed facilities. Typically, however, these tools are one-way interactions in which the operator shows representations of a facility or process to a passive audience. This is a missed opportunity. These tools are well-suited to support a two-way dialogue with stakeholders that can both educate and build trust and confidence.

Just as in the first concept which advocated for the expanded use of existing monitoring tools, this concept advocates for the expanded use of existing design tools.

With relatively limited additional investment, detailed design tools can be used to engage stakeholders in a discussion about the nature of a future facility, to consider what kinds of information the stakeholder would find of use, and to negotiate how that information might be acquired and provided. This method can help reduce concerns that key operations are being hidden and can help demonstrate both the opportunities and limitations of monitoring. By virtually walking through the facility together, the operator and stakeholder can come to an agreement on the relevance of information and an approach to providing access to that information.

This approach also makes it easier for operators to quickly and accurately assess whether particular stakeholder requests are likely to raise security concerns (e.g., by providing sensitive information), create additional burdens on operators, or risk the dissemination of proprietary information.

4.2 Evaluating Integration Opportunities and Design Efficiencies

The same modeling and visualization tools used to engage with stakeholders can be used to develop the most effective and efficient monitoring and data acquisition approach. By looking at the facility or process as a complete system, operators and regulators can work together to determine the optimal location of key measurement and data acquisition points and how to ensure that they are minimally constraining to operations before the facility is ever constructed. This “monitoring-by-design” process can yield substantial savings in both the short and long-term. Some recently constructed, complex nuclear facilities have seen their costs double post-construction due to the *ad hoc*, post-start-up addition of sensors and monitoring equipment.

These tools can also provide a mechanism to evaluate authentication and data security strategies. The ability to determine where conflicts may occur and where sensors or data transmission lines are potentially vulnerable to tampering or alteration can allow operators to address problems early. In many cases, once a facility is operating, these potential problems simply can not be fixed as they occur in areas of the facility that are inaccessible. Addressing these issues early can result in cost savings, but more importantly, it can add to a foundation of trust between operators and stakeholders.

Just as the provision of raw data to stakeholders is often of limited value, even the most detailed and comprehensive modeling and visualization tools may obscure and confuse more than they reveal. For this reason, these tools will need to be accompanied by the development of model “evaluators” – analytic tools that help to answer specific questions about the facility and process. Evaluators may aid in the identification of key measurement points to demonstrate compliance with nonproliferation, safety, environmental, and security

norms, assess the performance of monitoring systems, and assess the integrity of operator owned data acquisition tools.

5. CONCLUSION

Enabling a sustainable nuclear energy future will require that nuclear operators manage the growing demands and expectations of both national and international stakeholders who want assurances that facilities are being operated in ways that comply with safety, environmental, security, and nonproliferation obligations. These groups want access to more information and they want regulators to monitor the activities of nuclear energy operators more closely. Nuclear operators and regulators must find cost effective ways to meet these demands and to more fully engage these stakeholders to build trusted partnerships that will enable the expanded use of nuclear energy.

This additional oversight may result in additional costs for operators just as operators are also being pushed to demonstrate the economic competitiveness of nuclear energy. It is in this drive for improved economics, however, that opportunity emerges. Enhanced monitoring of operations and processes can also help operators as they seek to monitor processes more closely to improve efficiency.

This paper reviewed two concepts which may help operators address the demands of stakeholders and build public confidence in ways that limit additional burdens and constraints. The first, an integrated monitoring and data management system, couples an integrated approach to data acquisition that seeks to reduce redundancies and take advantage of all available monitoring tools, with a data management approach that allows for maximum flexibility in responding to the information needs of external stakeholders and operators. This data management system would allow managed, secure access to specific, authenticated data streams and analytic results for particular stakeholders.

The second concept, an expanded use of modeling and visualization tools to help educate and engage stakeholders, builds on the first. These tools, if properly developed, could serve as the basis for negotiations between operators, regulators, and stakeholders to determine what information was desired and to demonstrate how that information could be provided in the most credible, trusted manner. In addition to serving this assessment function, these modeling and visualization tools could also help operators and regulators design monitoring approaches that optimized sensor placement and ensured maximum confidence in transmitted data. Building confidence among stakeholders, therefore, would be complementary to efforts to reduce the costs and burdens on operators and regulators.

As nuclear energy producers contemplate the construction of new facilities, incorporating these concepts may offer opportunities to both build public support and reduce costs.

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