Nuclear Facility Transparency: Definitions and Concepts

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Abstract

The Cooperative Monitoring at Sandia National Laboratories has traditionally focused on "Achieving Security Cooperation through Technical Collaboration". In the course of developing collaborative activities, they have investigated the benefits of implementing monitoring systems that enable stakeholders access to information relative to nuclear energy facilities. Their efforts have resulted in definitions and concepts of transparency as a tool to further education of the population at large as well as addressing concerns that neighboring regions may have relative to operating nuclear facilities in close proximity to their homes and borders.

This paper presents a summary of definitions and current concepts of using transparency, and emphasizes collaborative efforts of Japan and the United States undertaken as a means to help all our communities better achieve nuclear transparency goals.

Introduction

Japan has long been committed to the peaceful applications of nuclear energy and development of the nuclear fuel cycle, while maintaining a high degree of transparency and non-proliferation that ensures the continuing trust of the international community and the trust, safety, and health of the people of Japan. Japan's long term nuclear energy development plans recognize the importance of economic and social factors associated with successful implementation of the nuclear fuel cycle. Transparency in the nuclear fuel cycle is an essential element in establishing a social consensus on the safety, economic competitiveness, and environmental issues that surround development of nuclear energy. Sandia National Laboratories (SNL) has collaborated with various nuclear energy entities within Japan for many years to develop and implement technologies necessary for safeguarding nuclear materials, and SNL is currently working with the Japan Nuclear Cycle Development Institute (JNC) to further their transparency and non-proliferation efforts. Sandia Labs is committed to the continuing support of JNC as they pursue their goals to become as transparent as possible to a wide range of both internal and external audiences. The purpose of this paper is to define and summarize current concepts on transparency as a means of helping all our communities better achieve our nuclear transparency goals.

Definition

The term "transparency" has been widely used to describe many different activities associated with safeguarding existing inventories of nuclear materials as well as disposing safely those nuclear materials that have been determined to have no further economic or strategic viability. In all cases, the fundamental principle of transparency has been to share pertinent information with interested parties. The Cooperative Monitoring Center (CMC) at Sandia Labs has facilitated many activities focused on the development of concepts relative to sharing of information[2][3]. The CMC suggests that transparency, as used in the context of peaceful uses of nuclear energy, be best defined as "*a cooperative process of providing information to all interested parties so that they can independently assess the safety, security, and legitimate management of nuclear materials.*"

Purpose of Transparency

We believe that transparency efforts should be able to address two questions fundamental to the safe development of nuclear energy. First, how do we establish that our nuclear activities pose no threat, either by accident or proliferation? Second, how do we establish that our neighbor's nuclear activities pose no threat, either by accident or proliferation? As the world populations have experienced adverse effects resulting from accidents associated with the peaceful use of nuclear energy, they have become increasingly more skeptical towards the continuing presence of facilities involved with nuclear materials. Recent accidents at Prototype Fast Breeder Reactor Monju, the Tokai Works' Bituminization Facility, and the JCO Fuel Fabrication Facility have particularly increased the fear and uncertainty of the Japanese people toward nuclear energy. Implementation of nuclear transparency technologies can be effective method of communicating with the local communities in order to share information and provide them with assurance that nuclear facilities are being operated in a safe and environmentally friendly manner. The local population needs to know that the air they breathe, the water they drink, and the food they are eat are free from any radioactive contamination resulting from operations at these nuclear facilities. Allowing open access to monitored data from operating facilities, as well as information and processes used in the course of decision making, are excellent examples of transparency efforts that may alleviate some concerns of the local population and their governmental entities.

Stakeholders

Identifying stakeholders is the method of targeting specific groups of interested parties in a manner that enhances the communication process. A stakeholder is any individual, or group of individuals, who have a vested interest in a given process. As related to facilities associated with nuclear energy, the stakeholders are commonly grouped according to whether their interests are local, national, or regional/international. These stakeholders generally share common concerns relative to operational and environmental safety, nuclear material diversion, and/or political and economic viability.

Operational and Environmental Safety: The local stakeholders are most generally concerned about those activities that have direct impact on their daily activities. They seek assurance that nuclear facility operations are conducted safely, and they expect timely notification of, and realistic indications of potential consequences resulting from, any unusual conditions. The local population, and their local governmental entities, expect nuclear facilities to be operated in accordance with published performance standards, and they expect open access to data associated with potential migration pathways for radioactive material leaving these facilities (i.e., air, water, food, etc.). A second group of stakeholders exist at the national level. While sharing all the concerns of the local stakeholders, these stakeholders are generally more focused on providing safety oversight and independent compliance evaluations of nuclear facilities located throughout the nation and the consequences of off-normal conditions beyond the local area. A third set of stakeholders exists at the regional/international level and is primarily concerned about nuclear facility issues that transcend national borders. It is worth noting here that the number of individuals accessing the web sites in search of radiation information relative to the Tokaimura area at the time of the unfortunate criticality accident increased dramatically. This demonstrates that, the general population will, in fact, utilize available transparency tools when they are seeking information relative to unusual nuclear facility situations, while seemingly ignoring these same tools during periods of normal operations.

Nuclear Material Diversion: The same three groups of stakeholders have concerns relative to the security of nuclear materials. They want to be assured that materials located within their respective region of interest are adequately accounted for and are used only for legitimate purposes. At a local level, residents need assurance that nuclear materials used for peaceful purposes are properly accounted for and that they remain securely within the boundaries of the nuclear facility. They also are concerned that adequate safety and security measures are

implemented to ensure than communities are adequately protected from incidents involving these materials during legitimate transportation activities. The national and regional/international stakeholders are more focused on treaty compliance issues and analyzing diversion pathways in order to adequately protect national, regional and international assets from credible threat scenarios.

Political and Economic Viability: Families who live in areas where these facilities are located often find themselves impacted simply by the presence of a nuclear facility in close proximity to the residences. Their quality of life is often influenced by their ability to trust those neighbors who work in these facilities and who are responsible for safe handling of nuclear materials located within the boundaries of nearby nuclear facilities. The economic value of their property, as well as their individual cost of living issues, can be significantly impacted by the presence of a nuclear facility in their community. Those that live within the community and actually work at nuclear facilities have some legitimate concerns relative to their individual privacy both on and off the job. Inadvertent disclosure of individual worker identities through transparency systems available to the public could result in repercussions from neighbors opposed to nuclear energy. These same individuals could also become targets of the local, national and/or international media in the event of unusual activities at nuclear facilities where they are employed. The national stakeholders must be assured that the owner/operator of nuclear facilities remains financially solvent in order to preclude accidents and incidents resulting from improper operation and maintenance of those systems intended to ensure safe operations. They must also be assured that facilities will be properly decommissioned at the end of their useful life, including proper disposition of all the nuclear materials associated with these facilities.

Transparency Implementation

Transparency associated with nuclear facilities will generally fall into one of two major categories. The first category includes access to actual data that results from monitoring operational and environmental parameters associated with operations at a particular nuclear facility. The second major category involves ensuring public access to information related to the decision making process associated with nuclear facilities.

Monitored/Measured Parameters: Most nuclear facilities include hundreds of sensors that provide to the operators valuable information which is useful for ensuring that internal processes remain functional and continue to perform their intended functions in an optimum manner. Other sets of sensors are associated with off-normal conditions and implement safety functions either automatically or in conjunction with a pre-determined manual response function by the facility operators. A third set of sensors provides information to the facility operators relative to the state of the environment in and around the nuclear facility, including those meteorological parameters that could potentially impact facility operations. Some of the information that these sensors provide to the facility operator could also impart a sense of comfort to the local population, assuring it that a nuclear facility is functioning in a normal manner. Providing communities with a “look inside” can be very helpful in diminishing the sense of secrecy that often surrounds nuclear facilities. A major transparency implementation issue is determining what information is important to the local population and what manner that information may be obtained without impacting the operations of the facility or inadvertently revealing sensitive security or personnel information.

Access to Information and Processes: Development of facilities intended for peaceful uses of nuclear energy is often a very lengthy and complex process that can consume many years or even decades of time before the onset of actual operations. One key ingredient to the successful completion of this tortuous process is gaining support from the local populations and their government agencies by ensuring that the process is open and honest from start to finish. With the modern day communication capabilities, large volumes of information can be made available to the general public using the internet as an information dissemination medium. Documentation associated with nuclear facility development must be available to the public in a format and

language level that is capable of being understood by every member of a community. The success of a nuclear facility-related program would be significantly impacted by the ability of a transparency program to accomplish this formidable task.

Transparency Risks

While implementation of transparency measures clearly will have benefits at many levels, the potential for negative impacts must be explicitly addressed. For example, dissemination of environmental and/or meteorological data may be an appropriate use for an internet site that is open to the public. However, similar open access to video images from an operating facility could inadvertently divulge information useful to groups that may be interested in diversion of nuclear materials, or those having other criminal intent. The following is a summary of some risks that have been identified during transparency workshops facilitated by the Cooperative Monitoring Center at Sandia Labs:

Risk of Misinterpreting Information: Providing access to raw data without including additional information on the context and technical significance of the data may result in high potential for misinterpretation. Consumers should be provided with some baseline information as well as sufficient technical context that allows them to appropriately interpret the potential significance associated with the data to which they are allowed access

Risk of Publishing Un-Reviewed Data: The degree of review or processing of monitored data impacts the timeliness associated with providing monitored data to the end-user. There may be a trade-off between providing near-real-time raw data versus data that has been screened and annotated to explain abnormalities in the information presented; however, there could be a resultant issue of credibility with some stakeholder communities.

Risk of Providing Operational Information: Operational information must be presented in a manner that ensures protection of processes and activities associated with facility security procedures. This may require some level of vulnerability analyses to protect operational information that could be considered attractive to organizations whose intent is to disrupt facility operations. This disruption could occur through demonstrating non-compliance with safety related operational requirements or through criminal activities such as sabotage or diversion of nuclear materials for illegitimate use.

Transparency Technologies

Sandia Labs has developed an effective internet-based monitoring system for dissemination of information intended to support transparency and non-proliferation efforts. The system consists of three basic functional levels: data collection, data storage, and data dissemination. The system accommodates collection of data through three fundamental interfaces. The primary collection of parametric data is accomplished using a commercially available Echelon local operating network (LON) in conjunction with commercially available sensors. The system is designed to produce an output signal that is proportional to changes in the monitored parameter. A second interface accommodates data acquired by digital and/or analogue video surveillance devices, and the third interface provides a capability to use electronic sensor platforms that transmit data using radio frequency to a central collection unit which is then hardwired to the data collection component. The collected data are then transferred into a data base and archived at the data storage component using a standard TCP/IP protocol. Finally, the data are transferred to a web browser using a file transfer protocol (FTP) for dissemination over the internet. For those applications where either surety and/or security of the data are a concern, various forms of authentication and encryption are available for application to the transmitted data. We are currently evaluating the feasibility of incorporating virtual private network (VPN) devices into local area networks (LAN) to provide protection to the IP address where the data originates and enhance the security of the computer networks used for transparency applications. Designs of

the web pages which present this transparency information to the end user is considered critical to ensure that pertinent information is transferred without overwhelming these individuals with undecipherable volumes of data.

Collaborative Efforts with JNC

During the last several years, Sandia Labs has worked with the Japan Nuclear Cycle Development Institute (JNC) Office of Nonproliferation to enhance its ongoing transparency efforts. These collaborative efforts have been performed using a DOE-JNC Bilateral Agreement for Cooperation in Research and Development Concerning Nuclear Material Control and Accounting Measures for Safeguards and Nonproliferation[4]. Included within the framework of this bilateral agreement are international fellowship research programs associated with both hardware and software components of unattended monitoring systems in the Experimental Fast Breeder Reactor Joyo at the Oarai Engineering Center.

JNC and SNL have designed and installed an unattended monitoring system in both the Spent Fuel Storage Building and the Fresh Fuel Storage Building of the Joyo Reactor Facility. Initially, the system design included only the Spent Fuel Storage Building and required that the data acquired by the monitoring system at Joyo be transferred via a telephone modem to a remote station at SNL for review. Transferring large volumes of data and video images using this modem-based data transfer function consumed many hours of communication time. The system design was expanded recently to include sensors in the Fresh Fuel Storage Facility and upgraded to use an internet-based Material Monitoring System (MMS) developed at SNL. The upgraded system will eventually allow direct access to the data dissemination component (DDC) using the internet as a communication medium; however, computer security restrictions at JNC currently preclude access to their LAN from external sources. We are in the process of modifying the computer communication protocols that will allow relocation of the DDC outside the JNC firewall and integration of a virtual private network (VPN). This VPN will afford adequate protection for the JNC LAN as well as ensure control of access to only those parties that have obtained necessary permissions form the JNC System Administrator. In the interim, we are currently using a manually initiated FTP process to transfer data to a stand-alone computer server located at the Cooperative Monitoring Center in Albuquerque, NM. Future efforts will be devoted to automated analyses of the acquired data and evaluation of related databases. This effort should result in enabling the monitoring system to offer some preliminary conclusions about the activities that have been detected without minimizing the end-users' ability to review as much detail as desired by that individual user. You are invited to visit the Joyo Web Site located in Albuquerque, NM; however, since the web site is password protected, I would suggest that you provide me with your user information and I will request permission from JNC to allow you to review the data. For demonstration purposes, the following is a guided tour of the Joyo web site (http://mms.cmc.sandia.gov/joyo/).

The most recent collaborative agreement between JNC and Sandia under the DOE/JNC Agreement involves Cooperation in Transparency. This project focuses on developing and maintaining a transparency web site where environmental radiation data from an existing Oarai Engineering Center monitoring system will be received from JNC and entered into a database designed by SNL. Naoko Nakashima from JNC's Health and Safety Administration at OEC will commence a one-year assignment to the Cooperative Monitoring Center in Albuquerque, NM in January 2001 to provide technical support to this Cooperation in Transparency effort. Technical personnel from both JNC and SNL will consult on the transmission format and quality assurance procedures. While JNC and SNL may agree to password-protect the data during the site initiation phase, it is intended that the database will eventually be opened either to subscribers or the general public by mutual agreement of SNL and JNC. JNC currently provides airborne radiation data from its Oarai Engineering Center and Tokai Works through publicly available web sites. This release of data is in line with Dr. Yasuma Togo's message that "JNC places great emphasis on safety, disclosure of information, and communication with the general public." Current

environmental data in Japanese and English is available in both data base format and graphically through JNC's Home Page (http://www.jnc.go.jp), or directly at their English language site: http://www.jnc.go.jp/zooarai/Oantai_e/html/index.html.

Council for Security Cooperation in the Asian Pacific (CSCAP)

The Council for Security Cooperation in the Asia Pacific (CSCAP) is a non-governmental organization that links together research institutes and security specialists from throughout the region in an attempt to build confidence through nuclear transparency. CSCAP's International Working Group on Confidence and Security Building Measures (CSBMs) is conducting an investigation into the feasibility of developing multilateral approaches toward ensuring the peaceful, safe use of nuclear energy. Their approach is to evaluate ways to increase nuclear safety and transparency and promote confidence among Asia-Pacific nations, while providing greater insight into regional nuclear-related concerns and potential acceptable solutions. The prospects of an increase in energy demand in the Asia-Pacific region, combined with the perceived need for energy security or self-sufficiency, have driven many countries to develop or at least contemplate the use of nuclear energy. This increased peaceful use of nuclear energy brings with it rising safety and non-proliferation concerns. Moreover, Asia-Pacific international cooperation in nuclear matters has been uncommon. In order to address these concerns, CSCAP's intended efforts in this field range from simple information gathering and dissemination on one end of the spectrum to examining the possibility of defining and promoting an international Asian or Pacific Atomic Energy Community (PACATOM) at the other. In between these two extremes are a variety of interim steps or measures that can address or alleviate regional nuclear energy-related concerns. Sandia's Cooperative Monitoring Center maintains a Nuclear Transparency web site (**http://www.cscap.nuctrans.org**) that includes many participants from within the Asian-Pacific Region. We have recently added near-real time radiation information from TEPCO's Kashiwazaki-Kariwa Nuclear Power Station to this site. We are also in the process of expanding to include links to pertinent Current Events, primarily those events of general interest to the nuclear power industry, such as FEPC's web site posting of the final report of the JCO accident. The Japanese participants in the CSCAP Nuclear Transparency Web Site currently include **Tokyo Electric Power (TEPCO)**, **Kansai Electric Power (KEPCO)**, **Japan Atomic Power (JAPC)**, and the **Japan Nuclear Cycle Development Institute (JNC)**

Other Transparency Activities

Neighborhood Environmental Watch Network **http://newnet.lanl.gov** : The Neighborhood Environmental Watch Network (NEWNET) is a network of environmental monitoring stations, and data storage and data processing systems, with public access to the data through the Internet and Environmental Teller Machines (ETM's). This allows interested members of the public to have constant access to the stations so they can observe the results at any time. A station manager from each community is trained in station maintenance, and has access to researchers and support organizations that can provide technical assistance if needed. Station managers serve as liaisons to their communities and can help citizens understand measurements. NEWNET was started in 1993 with stations in Nevada, California, Utah, and New Mexico. It is based on concepts developed by the Department of Energy for the Community Monitoring Program at the Nevada Test Site Nuclear Testing Facility. Stations can vary in configuration; however, most NEWNET stations have sensors for monitoring wind speed and direction, ambient air temperature, barometric pressure, relative humidity and ionizing gamma radiation. Some stations have tipping bucket rain gauges and others have additional radiation sensors. Additional types of sensors are being investigated for air quality and water quality measurements.

Waste Isolation Pilot Plant **http://wippdsc.wipp.carlsbad.nm.us** : The Waste Isolation Pilot Plant (WIPP) is the world's first underground repository licensed to safely and permanently dispose of low level transuranic radioactive waste left from the research and production of nuclear weapons. After more than 20 years of scientific study, public input, and regulatory struggles,

WIPP began operations on March 26, 1999. Located in the remote Chihuahuan Desert of southeastern New Mexico, project facilities include disposal rooms mined 2,150 feet underground in a 2,000-foot thick salt formation that has been stable for more than 200 million years. Transuranic waste in the U.S. is currently stored at 23 locations nationwide. Over the next 35 years, WIPP is expected to receive about 37,000 shipments. Sandia Labs is currently working on a DOE funded transparency experiment that involves providing access to many environmental parameters associated with the underground transuranic repository.

Summary

Sandia National Laboratories' is committed to continuing its support to the development of confidence building measures through the use of nuclear transparency. We look forward to an ongoing relationship with our Japanese colleagues from both the governmental agencies as well as those within the commercial nuclear industry. While our primary emphasis is currently focused on promoting transparency through applications of remotely-accessed unattended monitoring systems, we continue to search for other viable avenues to enhance confidence building and to achieving cooperative security objectives through technical collaborations. You are invited to review Sandia Lab's Cooperative Monitoring Center Web Site at http://www.cmc.sandia.gov.

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[1] Sandia is a multi program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94-AL8500

[2] Summary of CMC/WIPP Monitoring Workshop, February 16-18, 1999, Albuquerque and Carlsbad, New Mexico

[3] Summary of the Workshop for Asian Nuclear Experts on Transparency in the Back End of the Fuel Cycle, July 24-27, 2000, Albuquerque and Carlsbad, New Mexico

[4] Agreement between the Department of Energy of the United States of America (DOE) and the Japan Nuclear Cycle Development Institute (JNC) for Cooperation in Research and Development (R&D) Concerning Nuclear Material Control and Accounting Measures for Safeguards and Nonproliferation, January 27, 2000