

An Update on Stakeholder Participation in the Environmental Cleanup of Radioactive Wastes in the UK, Japan and US - 10390

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ABSTRACT

We review our program of research on stakeholder participation with environmental cleanup from radioactive wastes in the United States, Japan and United Kingdom (e.g., [21,26,27,66]). Citizen participation programs in all three countries are at different stages: mature in the US, starting in Japan, and becoming operational in the UK. The US issue at the Savannah River Site (SRS) in South Carolina (SC) had been focused on citizens encouraging Federal (Department of Energy, or DOE; Environmental Protection Agency, or EPA) and State (SC's Department of Health and Environmental Compliance, or DHEC) agencies to aggressively pursue "Plug-in-RODs" at SRS to reduce the paperwork involved in order to accelerate the closure of seepage basins at SRS. The issue in Japan is an effective division of labor among participants and the representation of different perspectives in the deliberation process, including citizens. The UK issue is centered around effective citizen participation with the UK's Nuclear Decommissioning Authority (NDA). Looking at our program of research, our hope is that a review of the programs in these three countries may improve citizen advisory programs.

US: SAVANNAH RIVER SITE CITIZENS ADVISORY BOARD (SRS-CAB)

There were nine CABs advising DOE in 2005 on waste management and environmental cleanup activities [21]. DOE's original and new guidelines seek consensus rules (CR): "To enhance compliance with ... DOE ... Encourage the Board [of citizen advisors] to listen carefully to all points of view and to work toward consensus" (p. 9 [58]; see also [6]). In 2005, however, only four of the CABs operated under CR, with five CABs permitted by DOE to use majority rules (MR).

SRS-CAB is a non-partisan group of individual stakeholders from South Carolina and Georgia (see [46]). Chartered under the US Federal Advisory Committee Act, its members chosen by DOE, SRS-CAB uses MR to provide recommendations to DOE on waste management, environmental remediation, and other activities affecting SRS. The 25 SRS-CAB members represent a wide cross-section of the residents who live, work and play close to SRS. About fifty percent of CAB members reside in counties adjacent to SRS with about 10 percent within 50 miles of SRS; most of the balance are drawn from among those who live downstream of SRS (e.g., Hilton Head, SC and Savannah, GA) [46]. Compared to the other CABs, especially the Hanford-CAB, SRS-CAB had significantly more diversity and college graduates among its members than the other CABs across the DOE complex [22].

US: DECISION MODELS

From a social physics perspective [21], agents act as a collective or as individuals. CR rules are widely considered to produce the best decisions by forging individual beliefs into a single worldview [6]. CR depends on enforced cooperation designed to preclude challenges; its goal is to allow those who normally would not speak in public a chance to contribute their views no matter how bizarre without fear of challenges by scientists or citizens using technical facts. However, when the preferences to be combined number three or more, no rational approach exists to aggregate individual preferences into a single collective decision [1]. Thus, CR decisions increase uncertainty by precluding recommendations for concrete action. Surprisingly, CR promotes risk perceptions (illusions) and inter-group conflict with those who are determined to act, specifically, the DOE sponsor, slowing action [21]. For example, gridlock on the Hanford CAB combined with years of litigation by the States of Washington and Oregon has led to enforceable mandates for tank waste cleanup at Hanford to speed up tank closures but instead that actually "extend the current schedule from 2018 to 2040" (p. 2 [74]).

We [22] have found that CR tended to increase the number of risk perceptions over risk determinations, promoting illusions instead of improving social welfare. Our findings agree with Kruglanski and colleagues [19] that CR serves authoritarian and special interest groups. By producing the "gridlock" at DOE's Hanford site (e.g., [74]), the CR Hanford CAB is an example [66]. CR decisions foster more illusions in the form of unchecked risk-perceptions than occurs under MR [25]. Negative perceptions surrounding nuclear issues are abundant. For example, in 1991, Slovic had predicted that the adverse risk perceptions about Yucca Mountain would harm the Las Vegas community's economy [39]. We countered to Slovic at a National Research Council meeting that in the decade since his prediction, Las Vegas remained the fastest growing community in the US (until the financial collapse in 2008). Slovic acknowledged our criticism in 2001 (pp. 102-3 [39]).

Majority rules (MR) are driven by a small number of competitive individuals who favor conflict. As a result, most MR participants become neutral to their technical arguments. But those driven by their interests to win must sway those neutral to their arguments [12],

dampening conflict [18], but producing concrete decisions. The reason why is that armed with the best empirical evidence available, competition sorts through the best ideas [13] as a group disambiguates its problems [5], increasing the concrete solutions available to a group. However, the polarization between the drivers of an argument reduces the chances that a consistent worldview can be recovered. Our findings [23] agree with those by Dietz and his colleagues [10] that conflict managed by majority rules promoted learning.

UNITED STATES

US: SRS-CAB AND "PLUG-IN-RODs"

With a focus on the U.S. Department of Energy's (DOE) Savannah River Site (SRS) in Aiken, SC, we review the history of "Plug-in-RODs" in the U.S. RODs are short for Records of Decisions, the public decision documents crafted for example by the State of South Carolina's Department of Health and Environmental Control (DHEC) in the cleanup of SRS. One consideration in the cleanup is that the treatment plan for each operational waste unit (OU) must be officially reviewed by the regulators DHEC and the Environmental Protection Agency (EPA) along with the public and the organization responsible for the cleanup (SRS) before the treatment plan becomes an official Record of Decision (ROD). But as a consequence, lots of time and energy are consumed with each ROD, making it a potentially cumbersome process. "Plug-in-RODs" were first started at DOE's Hanford Site but not promoted by the Hanford Citizens Advisory Board (CAB), unlike the CAB at SRS [68]. A Plug-in-ROD is where a treatment plan for a target waste unit is similar to other and previously approved and treated OUs. In that event, the successful treatment plan for the new waste unit could potentially be grouped with the prior OUs from a regulatory perspective, thereby reducing significantly the paperwork needed. Instead of a unique set of documents (RODs) for each OU, a set of waste units with similar contamination history and to be treated similarly could be covered by one overarching set of RODs that became known colloquially as "Plug-in-RODs" [68]. The recently reviewed Early Action Proposed Plan to close the remaining reactor complexes at SRS followed a similar course [69]; in that they were similar to the P-Reactor complex that had already obtained a successful ROD for its closure plan, the remaining reactor complexes followed the same pattern [68].

From the CABs recommendation [68]:

The Department of Energy-Savannah River (DOE-SR), in concurrence with the Environmental Protection Agency-Region IV and the South Carolina Department of Health and Environmental Control (DHEC), plans to employ a Plug-In-Record of Decision (ROD) to the selection of a common remedy for multiple environmental remediation Operable Units (OU's) that meet the following criteria: radionuclides are the primary soil contaminants, the OU is located in an industrial zone, the OU contains soils with principal threat source materials ... and its contaminated soils are not in direct contact with surface

water or groundwater. The selected common remedy is In Situ Stabilization with a Low-Permeability Soil Cover. Remedy selection was based on the Old F-Area Seepage basin and the L-Area Oil and Chemical Basin Record of Decision. Both of the remedy selections for these OU's have been reviewed and supported by the Board ...

Plug-In-ROD's streamline the remedy decision process, reduce documentation, and facilitate quicker cleanups. The result is a more efficient process that costs significantly less. Candidate OU's are "plugged" into the primary ROD, replacing the individual ROD's currently required for each OU. This approach has been used successfully by EPA at other Superfund sites and at the DOE Hanford site (e.g., it was first developed by EPA at the Indian Bend Wash Site in Tempe, AZ). It has been endorsed by EPA's National Remedy Review Board. Remarkably, despite the significant benefits provided by the use of Plug-in-ROD's, the SRS CAB is the first Board in the DOE complex to endorse the Plug-In-Rod concept [73].

The four candidate OU's consist of eight unlined reactor seepage basins used to purge radioactive process water from reactor disassembly basins. Each has a similar history and similar contamination characteristics. The candidates are the three C-Reactor seepage basins, K-Reactor seepage basin, L-Reactor seepage basin, and the three P-Reactor seepage basins. While the first candidates have been selected, other OU's that satisfy the criteria will be considered later under the Unit-Specific Plug-In Decision Document.

The SRS CAB then recommended [68]:

As the first Citizens Advisory Board (CAB) to endorse this concept and see it come to fruition, the CAB commends the three agencies for making the concept of Plug-In ROD's a reality at SRS. We recommend that each of the three agencies build on their very fine accomplishment by making a commitment to expand the use of Plug-In ROD's at SRS to significantly reduce the costs of cleanup, the regulatory paperwork, and the time involved in achieving actual site remediation in the field.

In their "Tri-Party" response [76], DOE, EPA's Region IV, and SC's DHEC wrote that they were "diligently pursuing the development and implementation of a streamlined approach to environmental cleanup, known as the Plug-in ROD approach." [75] In a concurring response, SC DHEC wrote that it appreciated and concurred with the recommendation and that it was implementing the Plug-in-RODs.

DISCUSSION

We have found a similarity between bureaucratic inefficiencies as solved by the Plug-in-RODs used at SRS and the inability of the Nuclear Regulatory Commission and DOE to reach final agreement on the point-of-compliance (POC) at the closure of the SRS high-

level waste (HLW) tanks [66]. In the case of the POC, no authority was given to either DOE or NRC, leading to "gridlock" on where to locate the POC.

Bureaucratic inefficiency and consensus rules (CR), we have argued, act as an impediment against accelerated cleanups [71]. The Hanford CAB is a CR board. CR board members for example are not allowed to contradict each other with the use of scientific facts [72]. The result is inefficiency in group decision-making, which is similar we have concluded to bureaucratic inefficiency [71]. Not only did the Hanford CAB failed to push Hanford to accelerate its cleanup by using Plug-in-RODs, it also allowed a negative relationship to develop between Hanford and its regulators. Very different from the positive working relationship between SRS and its regulators fostered in no small part by the majority rule (MR) Citizens Advisory Board at SRS, the DOE Hanford facility in the State of Washington was successfully sued by its regulator, the end result of the settlement accord being that a significant slowdown is to occur in the closure schedule for the Hanford high-level waste tanks [74], from 2018 to 2048.

In contrast, with the public CAB and the three agencies working together under the CABs majority rules, significant acceleration was achieved in the closure of the SRS seepage basins. This led to a commendation issued by the SRS CAB to the three agencies [77]:

The SRS CAB enthusiastically supports [the Plug-In ROD process]. Release of the ESD ["explanation of significant difference" that allowed the Plug-in Rod to be used on a previously uncovered seepage basin] permits the CAB an opportunity to commend the three agencies on their effort to significantly reduce the costs of cleanup, the regulatory paperwork, and the time involved in achieving actual unit remediation by using the Plug-In ROD process. It is a great accomplishment for all parties (stakeholders and the three agencies) to see a concept become a reality.

JAPAN

JAPAN: STAKEHOLDER PARTICIPATION IN NUCLEAR WASTE ISSUES

Various organizations in Japan share the responsibility for nuclear energy control and radioactive waste management. Its Atomic Energy Commission (AEC) and the Nuclear Safety Commission (NSC) are affiliated with the Prime Minister's Cabinet Office. AEC "plans, deliberates, and makes decisions on national policies relating to the utilization of nuclear energy" [29]. Since 1956, AEC has announced nine Long-Term Programs for Research, Development and Utilization of Nuclear Energy (Long-Term Programs). From its Long-Term Programs, the Agency for Natural Resources and Energy (ANRE) of the Ministry of Economy, Trade, and Industry (METI) implements the plans for power generation and related nuclear fuel cycle activities [29]. METI oversees the Nuclear and

Industrial Safety Agency (NISA), which regulates the nuclear energy industry and tracks its problems [30].

NSC is responsible for designing and enacting safety regulations. Their task forces encompass a wide range of issues from waste management to facility designs to fast breeder reactor problems. The Radioactive Waste Management Funding and research Center (RWMC) is specialized in research on radioactive waste management. Another research organization is the Nuclear Waste Management Organization of Japan (NUMO).

Radioactive waste management in Japan is controversial. But there are very few organizations that represent the middle-of-the-road perspective. The government officially endorses the development of nuclear energy. Non-governmental organizations (NGOs), like the Citizens' Nuclear Information Center (CNIC) that advocates for the abolition of nuclear power, are not brought in for wider deliberation processes involving government agencies and the nuclear energy industry.

In short, there are various stakeholders and decision makers involved in the development of nuclear energy policies in general and the management of radioactive waste materials in particular in Japan. The division of labor is not always straightforward. Not all perspectives are well-represented in the deliberation processes, either. Through reports reviews and public comments, however, NSC attempts to incorporate a broad spectrum of interests.

JAPAN: STAKEHOLDER PARTICIPATION

There is no established stakeholder participation process in nuclear decommissioning issues equivalent to citizen advisory boards (CABs) in the US or the UK. The Long-Term Program for Research, Development and Utilization of Nuclear Energy (accepted by the AEC in 2000) acknowledged the need for greater citizen involvement in nuclear decision-making in general. AEC launched an ongoing series of Conferences for Public Participation and Decision Making for Nuclear Energy Policy in 2001. The Conference members consist of nine “specialist” members, including journalists, university professors and pro-nuclear energy activists. The conferences typically feature invited speakers followed by comments from the floor from about 100 participants. The Conference has some meetings open to the public in various places (e.g., in 2006, Himeji, Sapporo, and Matsue). The topics of the conferences are Public Relations (PR) activities and information acquisition regarding nuclear power plants.

AEC is committed to increasing citizen participation in nuclear policy formulation processes. But it is not clear how it is achieving its goal. The conference is less about waste management than about nuclear energy. Other issues include earthquakes, job creation, public education, crisis management plans, and etc. The conference members and invited speakers are selected by AEC by an unknown process. The format of the Conference offers little opportunity for deliberation. The gatherings are held in different locations with an identical theme. Regular attendance is not expected. The deliverables of the Conference are not defined. Finally, because decision-making and sustained

deliberation are not the focus of the Conference, rules regarding decision making are unspecified. The choice between CR and majority rules (MR) has not been considered. The public gatherings are extended question and answer sessions. AEC's outreach attempts are by far the most advanced and ambitious in that it seeks inputs from the general public even though the effectiveness of its approach is not yet analyzed.

At other agencies, the issue of stakeholder involvement is rarely raised, if ever. From publicly available sources ([64],[65]), it is not clear whether any of them are working with officially designated groups of stakeholders. According to NISA, it does not involve stakeholders in its decision-making. NISA and the Japan Nuclear Safety Organization (NSO) alone are responsible for inspections and decisions regarding nuclear applications and nuclear operations [66].

Stakeholder participation in the environmental cleanup from nuclear waste operations is still in an inchoate stage in Japan. In October 2009, the Cabinet Office conducted a survey on nuclear power in order to understand public attitudes to nuclear power (Authors' Note: similar surveys on nuclear power were conducted in 2005, 1999, 1990, and 1987 with slightly varying questionnaires [67]). The population of the survey is adult residents of Japan. 3,000 subjects were randomly sampled, out of which 1,850 responses were obtained (62% response rate). It asks questions about awareness and perceptions about nuclear power. Questions about knowledge about nuclear power generation reveal that 54% know that nuclear power generation produces high-level radioactive waste. Forty-six percent know that nuclear power accounts for about 30% of Japan's electricity production. Nineteen percent know that the proportion of nuclear power in the total national electricity production reaches more than 50% in some countries. Asked about the most desirable policy regarding nuclear power, 50% chose "Japan should expand the use of nuclear power with caution." Nineteen percent prefer the status quo. Fifteen percent want to phase out nuclear power.

Fifty-four percent express concern about safety in relation to nuclear power generation [67]. Allowing multiple choices, the survey further asks why they are worried about safety. Seventy-five percent of respondents believe that there exists a possibility of accident in Japan. Fifty-three percent are concerned because Japan is an earthquake-prone country. Forty-two percent say that they do not feel safe because they do not know what kind of safety measures are taken by the government. Thirty-two percent do not think that the government is doing enough to keep the citizens apprised of nuclear power policies. On the other hand, 41% feel that nuclear power generation in Japan is done safely. They list the track record of safe operation of the power plants, trust in the government, and trust in the industry among the reasons they feel safe.

The survey asks whether the respondents would approve of the construction of high-level waste repository in their community. Remarkably, 80% would disapprove of a repository in their community [67].

The survey [67] demonstrates that nuclear waste management remains a controversial issue in Japan. The majority of the population accepts that Japan has to depend on

nuclear power generation, and yet the NIMBY ("not in my back yard") attitude about a nuclear waste repository is prevalent.

JAPAN: CONCLUSION

Citizen participation is new to Japan. Government agencies regard the public as representing undifferentiated interests. It is not even clear whether stakeholders have been involved in the decision-making processes. As a result, relationships between the agencies and citizens are more like one-way communications of public relations rather than deliberation.

JAPAN: FUTURE WORK

Our key issues are twofold. First, we must identify facilitators and obstacles to greater citizen participation in nuclear waste management. Traditionally, Japanese government agencies as well as private sectors have been following innovations in business and management practices. We hope to examine whether and how AEC and other Japanese agencies involved in waste management learn from the experiences with having citizen advisors to national nuclear agencies as occur in the US (SRS CAB) and the UK (below). The practice of learning from experiences of other organizations and societies can be conceptualized as "institutional isomorphism." [62] Before DiMaggio and Powell, organizational structure was thought to arise from market efficiency; instead they concluded that it arose from institutional constraints imposed by the state and professions, promoting rationality under uncertainty and constraint led to structural homogeneity (institutional isomorphism). Drawing on theories of institutional isomorphism, future research will address both within-country isomorphism as well as between-country isomorphism. Organizational learning is not always a fast process. For example, Japan's Administrative Procedure Act is based on the US APA of 1946,¹ but after decades of deliberation, it was not enacted by the Diet until 1993. The presence and pace of learning processes are informative of the priorities of Japanese government agencies. Relevant questions to be addressed in the future include:

- Are Japanese government agencies aware of initiatives in other societies to facilitate citizen participation in nuclear waste management?
- Are they aware of and interested in activities of having citizen advisors to national nuclear agencies (such as the US and the UK)?
- Which agency is more committed to promoting citizen participation in nuclear waste management?

Second, there is an issue of decision-making style. Which is more dominant, consensus rules (CR) or majority rules (MR) in discussions regarding developing or not developing the system of citizen advisories, if any? Do the agencies explicitly endorse a particular

¹ The US Administrative Act, 1946, authorizes and governs how US government administrative agencies create and establish federal regulations. It authorizes the federal courts to oversee the agencies; see en.wikipedia.org/wiki/Administrative_Procedure_Act.

principle?

UNITED KINGDOM

UK: STAKEHOLDER PARTICIPATION IN NUCLEAR DECOMMISSIONING

The aim of Nuclear Decommissioning Authority (NDA) and the National Stakeholder Group (NSG) are manifold ([57]; see also [26]). Regarding the long-term disposal of higher activity radioactive wastes, NDA is “working with government and communities on the programme for the implementation of geological disposal for higher active wastes” (an R&D workshop on geological disposal was held in 2008 [57]). This particular aim implicates the desire of NDA and NSG to work with stakeholders (NDA inherited a nuclear legacy of 19 sites, mostly shuttered, where nuclear R&D was conducted).

A questionnaire was designed as a component of a PhD (by Whitton) at the University of Manchester to study stakeholder engagement processes for stakeholders participating in the NDA and NSG beginning in 2006. The aim of the questionnaire was to elicit stakeholder views regarding current NDA stakeholder forums, particularly stakeholder perceptions of a ‘dialogue based’ description of the process and the authors' hypothesis that effective engagement requires dialogue to be deliberative in nature if resilient decision making is to take place as a result.

At the time that the first questionnaire was issued by NDA, NSG was just over a year old and had held three national meetings. Of the seventy-seven stakeholder organizations invited to the third NSG, 57 attended. From these, 33 replied to the questionnaire. A second questionnaire was issued to the group in May 2008, to assess any shift in stakeholder perception and attitude towards the process following a period of 18 months and a further three meetings of the NSG. Fifty-two stakeholder organizations attended NSG-6, and from these, 25 replied to the questionnaire.

UK: CONCLUSIONS

The ability of participants to express views, engage with NDA, understand other stakeholder positions and expect transparency are all high priority issues for the participants who replied to the questionnaires. But the stakeholders remained confused regarding the extent of their influence and role at the NSG.

NDA has demonstrated a significant commitment to stakeholder engagement, both in terms of time, cost and availability of staff members at both the nuclear site and national level to be available to stakeholders. But NDA did not provide a transparent account of how participants influence the outcome of meetings and ‘NDA thinking’. Although much informal discussion by stakeholders took place during each of their meetings, it did not translate into a formal demonstration by NDA of stakeholder influence. NDA has not produced the evidence for its decisions as a result of participant comments, to match the

commitment that they have demonstrated to stakeholder engagement over the last two years. This is a missed opportunity in the minds of stakeholders and decision making resilience for future iterations of NDA Strategy.

UK: FUTURE WORK

We are currently attempting to arrange a workshop with all those who completed questionnaires and agreed to attend at the next NSG (the 7th NSG meeting occurred in November 2008; NSG-10 is forthcoming in March 2010; see the NDA website for additional information [57]). The aim is to discuss specific findings of the questionnaires surrounding the stakeholder lead approach adopted by NDA, transparent links between NDA decision making and the engagement process. In addition, a further aim is to clarify stakeholder views regarding our hypothesis that effective engagement requires dialogue to be deliberative in nature if resilient decision-making is to take place as a result.

UK, JAPAN, AND US: THEORY PERSPECTIVE

From a theoretical perspective, it is important to note that dominant voices are constantly heard during SRS-CAB discussions. As in the UK, interviews and surveys of the SRS-CAB indicate that these dominant voices are not uniformly appreciated [6]. But dominant voices have accelerated the cleanup at SRS in comparison to the gridlock observed at Hanford [22],[23]. This is especially true with the " Plug-in-RODs" at SRS. Moreover, even though negative comments about the presence of dominant voices are noted on surveys of SRS-CAB members, they have not been articulated in public by members of the SRS-CAB and have had no observed impact on its decisions to accelerate cleanup.

We have recently proposed [26] to adapt feedback control theory to a theory of organizations. Control theory describes inputs versus outputs in complex systems [9]. We propose that it as a more objective methodology to evaluate the Hanford CAB where worldview stability governs the decisions of its members and the SRS-CAB where accelerating cleanup governs its members. To implement control theory, we need to quantify systems level models. In line with earlier arguments, a CAB controls at least four aspects of the decision-making process. First, by helping to set or choose its reference or threshold set-points (e.g., culture, decision processes, expectations, planning). Second, by damping unexpected disturbances. Third, by filtering and transforming incoming information about system internal states, inputs, and responses to form patterns and decisions. Finally, by taking actions such as collecting new information or to produce CAB advisory decisions. However, DOE has recently taken over the control of its SRS CAB.

Four interdependent metrics have been proposed as control measures. These are the uncertainties associated with planning and plan execution; and the parallel uncertainties associated with the resources available for execution and the duration of a plan's execution. For example, in a retrospective field study of stakeholder decisions on transuranic wastes collected from all of DOE's CABs existing at the time, we found

support for the only two of these four factors that were measured [21]: In 2003, all nine of the existing boards were requested by DOE to support thirteen recommendations by DOE scientists to accelerate the shipment of transuranic wastes to WIPP. As predicted, four of the five MR boards supported the recommendations proposed by the DOE scientists, whereas three of the four CR boards rejected their advice. The MR boards on average took about 1/4th the amount of time to make their decisions compared to the CR boards. As observed by scientists in other venues, the lengthy duration required to reach consensus can be draining to participants [33].

In related research [16],[25], we have begun to convert the metrics above into four interrelated standard deviations. In the revision, first, duration data (t) is transformed into frequencies (ω) for which we can calculate energy and the standard deviations for both, where $\sigma_t \sigma_\omega \geq \frac{1}{2}$ [7],[34]. Initial results are supportive: organizations make decisions regarding mergers and acquisitions not only to become more competitive, but also to seek stability; e.g., Washington Group International,² which until recently was the primary contractor at SRS, recently merged with URS Corporation to form the nation's biggest engineering and construction firm that is "more diverse, nimble during economic slowdowns, and better positioned for contracts ... and alternative energy ventures." [2] Second, we are crafting our theory in line with the work begun by Lewin [28]. We predict that the focus of a group is divided between the location of an event it is planning interdependent with the spatial frequency of others in a chain of events; as part of a tradeoff among uncertainties, focusing on one event occurs at the expense of the others.

CONCLUSION

What has been found for individuals seems to agree with our findings for organizations. For an individual, greater expenditures of effort are associated with higher cognitive functions, leading to an increase in the ability to resolve mental maps of reality [59]; words spoken in anger expend about twice the energy of regular voice [25]; and when performing a complex military exercise, compared to experts, the brains of novices light up like a Christmas tree, indicating the effort wasted by novices versus experts [61]. The goal of an individual brain is to minimize wasted energy expenditures in order to maximize the free energy available [60]. Similarly for organizations, competition leads to more conflict--reflecting a greater expenditure of effort--and if channeled properly with feedback, it can produce more efficient and effective decisions and with less time wasted during the decision process. As concluded for the UK's NDA, getting the public behind an agency is crucial to achieving the acceleration in cleanup that has been experienced by SRS. But also, when a national agency goes against its citizen advisors, it pays a significant price, as found in the gridlock at Hanford. However, when these groups align their plans and support to reach an "action" consensus, usually from a competitive process, as when SRS and its CAB reached an agreement over the Plug-in-RODs to accelerate the closure of seepage basins at SRS, acceleration, efficiency and effectiveness were the outcome, exactly the stated goal of the UK's NDA. Finally, we

² For the current mission of WGI, see www.wgint.com/markets/energy_environment.

speculate that these positive results we have identified for citizen participation will generalize to Japan as well.

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