Shouldering Risks: The Culture of Control in the Nuclear Power Industry.

Constance Perin. Princeton, NJ: Princeton University Press, 2005. 378 pp. $35.00.

Shouldering Risks provides a window into a key facet of the culture of U.S. nuclear power operations—an insistence on a tightly controlled technical and procedural world of producing electricity by this means—and some of the dynamics, perceptions, and norms that accompany it. Constance Perin's study is a penetrating and worrisome analysis of life in several nuclear-powered electricity production stations similar to those on which a number of industrial societies continue to depend. The book searches out the perceptual views and informal norms that have arisen among those technically trained, engineering-oriented operators who bear the actual burden of keeping us safe, "first operators," so to say, in the face of overriding institutional (read executive, regulatory, and congressional) pressures to keep production timely while reducing costs.

Perin seeks to understand "what it means for people to handle real-time risks with minimal consequences some of which the design [of the technical system] itself introduces" (p. 280). In the process, she crafts keen, ethnographically informed descriptions and insights mainly through the prism of "event reviews"—formal reports triggered by near-misses, procedural lapses, and accidents in power plant operations—enhanced by the perceptions of some 60 of the people who prompt and conduct them. She finds these reviews to be the key process in the institutions' "cycles of self-improvement" (p. 28). Through an ethnographic lens, she observes persistent patterns of sluggishly implemented changes recommended to address emergent safety problems, especially those that involve assuring the safety of operators and, ultimately, of citizens. The dynamics around deciding when to shut down a reactor and limiting radiation exposure are her central concerns.

The empirical core of the book, in three descriptive chapters, consists of discussions of four "event reviews," two conducted by experts in one power station, one each in two others. These events sweep across a number of the functions within the stations. In one plant, it is a persistently leaking valve of the reactor cooling system that could lead to uncontrolled superheating of the coolant and possible melting of nuclear fuel. In another, it is, first, an inadvertent "trip" of an electrical switch that resulted in an immediate and costly automatic shut down of a nuclear reactor and, second, a breach of administrative review procedures that allows temporary contract workers engaged in refueling the plant to have unescorted access. A fourth event review, in the third station, examines a chance discovery of a "hot spot" in a generator step-up transformer (which handles very high levels of electric current) that if undetected could have resulted in a major fire and possibly fatal injury. Although it was not directly a reactor-related problem, this discovery resulted in a costly shut down. Each of these events triggered extensive internal examinations and regulatory attention.

Perin's accounts give us, first, the parameters of the incidents that prompted the event reviews. These are thick descriptions that evoke the administrative and technical terms used in each station, affording a glimpse into the mix of operational dialects that frame perceptions and meaning and modulate interactions between operators and experts. The descriptions introduce readers, sometimes obliquely, to a world of massive machines, extraordinary engineering and procedural complexities, and the persistent sense of danger and anxiety about maintaining a sometimes precarious balance between plant and personal safety and continuity in production.

To frame her ethnographic insights, Perin uses a conception of a culture of control that takes into account the tensions between formal legal regulation and self-regulation, persistent "trade-off quandaries," and a somewhat novel analytical offering, several "orders" or "specialists' concerns and commitments" (p. 16). "Orders" are systematic means of bringing cognitive order to "the technological and financial ambiguities of risk" (p. 16) and are similar to notions of professionalization, epistemic communities, and anthropological conceptions of clans, though it is unusual for a scholar to take such conceptions so deeply into systems of hazardous technologies. Perin notes a tangle of these "orders"—a corporate and a regulatory order, a market and production order, a naval or military order, and a materials order—and "nested within [these orders] are professional orders (chemistry, engineering, finance, health physics, management, occupational safety . . .). . . . Each order relies on its own concepts, techniques and sources of authority," and though they may be interdependent, "they are not always compatible" (p. 18). Each has its internal status rankings, each its hierarchy of knowledge and bureaucratic skills. And each has its internal conflicts over values, strategies, and tactics. This array of "orders," brought to event reviews and informing everyday operations, prompts different meanings to be attributed to similar technical and organizational phenomena. These become the source of tension and conflict and negotiations about commitments. Perin emphasizes this notion of "orders" in the core ethnographic chapters, returning to it in her conclusions to provide an explanatory framework for what she sees.

The book reflects Perin's remarkable persistence in gaining a high level of trust from wary power station staff in a contested industry. Perin ranges widely across the literatures of engineering safety systems, the debates about nuclear-dependent institutions, studies of complex organizations, and the social science of technology and society. She builds on these and her interviews with operational "experts," in her terms, scattered across the primary networks of each station to tease out insights from each case through the words of these experts themselves. The muted drama beneath the technical and operational dialects of these participants gives immediacy, sometimes urgency, and often anguish to their reflections, which is unusual for studies of the social dynamics in large technical systems. Throughout the book, Perin brings flashes of uncommonly graceful language and a sense

of empathy for those with whom she spoke, which adds color to the usually bloodless dialects of probabilistic risk assessment, engineering systems, and cost benefit analysis that have come to typify discourse about industrial nuclear operations.

Perin speaks directly to leaders and analysts in the U.S. nuclear power industry, their regulators, and the designers of our next generation of nuclear power technologies. She presses them to take much more seriously the effects of technical design on operations, on exacerbating the inherent trade-off quandaries, and in perpetuating confusion about coordination among different "orders" and logics of control. She also challenges scholars in the science, technology, and society domain, public policy practitioners, engineering school faculties, and social scientists to realize the analytical power of delineating micro-cultures within the widely dispersed "orders," or analytical communities and commitments of today's large technical systems.

The book poses a challenge for readers who expect considerable detail about the larger industrial, plant, or regulatory context to help them situate this work in relation to existing essays and books about nuclear power, which are typically framed as part of the long-running policy debate about expanding the use of nuclear reactions to boil water and produce steam-generated electricity. Perin is mainly interested in the other vectors in this debate, those that vary the risks of operations for the surrounding community. This work is likely to be added to Perrow's (1983) work on "normal accidents" and Gusterson's (1996) *Nuclear Rites,* a study of a U.S. nuclear weapons lab, in courses concerning the problematics for democratic societies when they depend on hazardous technologies.

Shouldering Risks provides useful, pithy summaries in the beginning and the end on the structure of this debate, but absorbing them requires concentrated attention. Those hoping for descriptions of nuclear power operations from the usual behavioral or science, technology, and society perspectives should go to the ethnographic chapters. A close reading of these chapters rewards those unfamiliar with this industrial terrain by providing glimpses of the remarkably tight and variegated world of nuclear station operations and "planned outage" management for periodic refueling of the radioactive core.

In the last two chapters, Perin returns to her central theme of the logics of control to explore the implications of the multiple "orders" involved with nuclear operations. Urging the reader to consider the "axes of meaning" within and surrounding nuclear operations, and the clear need to enhance coordinative processes to reduce confusion, Perin ends the book with reflections on increasing the intellectual capital underwriting the mix of legal regulation and self-regulation that she expects to animate U.S. practice. She proposes a research agenda to enhance processes encouraging "doubt and discovery," which "keep us safe" (p. 263). What patterns of coordination and norms will contribute to the "negotiating processes [in making trade-offs] that demand explicit

rationales and robust analyses" for deep root-cause investigation? The importance of an "axis of meaning" that frames the views of operational experts, and the ambiguities this produces, prompts Perin to argue for greater investment in understanding "safety significant relationships among various *kinds of knowledge* for reducing uncertainties" in parallel with "understanding material components, processes, and their relationships" (p. 272). Finally, she proposes research "to develop understandings of [control] logics' structure and dynamics and their part in events and nonevents, to inform [reactor] *design*" (p. 279). These are very demanding injunctions, calling much more on social science perspectives than on engineering ones. I suspect that social science conceptions and methodologies will need to be further developed to accomplish such research.

The book is also a muted cry of citizen alarm, cloaked in an ethnographer's self-consciousness. Perin's synthesis and qualitative analysis points to a much deeper, long-term problem than is either formally advanced in the book or is likely to be perceived by political or technological leaders who are in positions to act in the space business, nuclear matters, and perhaps bio-engineering and other less obvious "risk increasing" domains being pursued by U.S. technical communities. Perin's work advances no solutions but does offer a view of the phenomena that, with considerable dialogue among technical and institutional experts, could result in a crisper recognition of the dilemmas we face.

I commend *Shouldering Risk* to each of the audiences noted above, not because it will directly help in solving problems—it won't—but because Perin's work tries to sort out the logics of control that arise in conducting operations judged by our society to be of such benefit that institutionalizing very hazardous systems seems justified. In the end, it is a worrisome picture, and I suspect it will evoke different types of objections from each audience. Her cultural treatment of nuclear power stations is likely to be particularly affecting for those who know this terrain. Perin's "axis of meaning" is also an axis of confusion and grounds for missed opportunity and danger. Her descriptions are replete with vectors to be pursued and analytical issues to vetted, and her conclusions point to serious matters of institutional policy. *ASQ* readers could see it as an urgent invitation to increase their efforts to explain cultures of control and cultures of accountability in a wider variety of hazardous settings and to pay great attention to the relationships of technical design to the behaviors, patterns of values, and incentives prompted by taking technically induced hazards seriously.

I end with two questions that kept recurring. I began to wonder to what degree some technologies imply that one of management's central tasks is to assure a culture of operator guilt as a condition of highly reliable functioning? One senses that this was in evidence at these nuclear power stations. This was followed by the query, How many of us academic observers of large-scale organizations, working in environments of wide discretion and mutual respect, would gladly take up work within the sorts of cultures of control Constance Perin describes?

Todd R. La Porte
Department of Political Science
University of California
Berkeley, CA 94720

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