Utilities industry

Resurgence of Nuclear Power:

Key considerations as the nuclear option is re-introduced

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The heart of the matter

Active interest in nuclear power is growing rapidly, creating immense opportunities for U.S. utility operators.

Resurgence in nuclear power

A confluence of trends is breathing new life into the nuclear power industry as nations around the world look for ways to meet the energy requirements of their societies and deal with the growing concerns about the environment and climate change. Many countries also have a growing desire to achieve a higher level of fossil-fuel energy independence.

With the belief that nuclear power can be safely employed, today we see rapidly maturing efforts to build new nuclear power facilities across the globe. Indeed, since 2007 in the U.S. alone, 17 license applications to build 26 new reactors were submitted to the Nuclear Regulatory Commission for approval, following a 30-year period in which few new reactors were built. Other countries, including China, India and the United Arab Emirates, have embarked on even larger-scale development programs to meet the growing needs in each of these countries.

As of January 2010, 29 countries worldwide were operating 437 nuclear reactors for electricity generation, with 56 new nuclear plants under construction in 14 countries.[1] The U.S. today is by far the top nuclear-generating country in the world, with 104 nuclear power plants in 31 states, operated by 30 different power companies.[2] In 1980, U.S. nuclear plants produced 251 billion kWh, accounting for 11 percent of the country's electricity generation. By 2008, that output rose to 809 billion kWh; nearly 20 percent of total electricity generation was from nuclear power.

Plant performance has steadily improved over the last decade. For the 11th straight year, 96 percent or more of power plants met industry goals for availability.[3] According to the NRC, power plants have redundant safety systems, are operated by highly trained staff, and have multiple barriers in place to protect the reactor and prevent or minimize off-site releases.

This represents an immense opportunity for utilities, which for three decades have been actively discouraged from pursuing the nuclear option. The build-out of new nuclear power plants represents a major enhancement to national energy grid modernization efforts.

In this report, PricewaterhouseCoopers (PwC) explores the key strategic, financial and operational issues that executives and shareholders should consider as the industry enters a new era of nuclear prominence in energy policy.

1 The Nuclear Energy Institute, http://www.nei.org/resourcesandstats/nuclear_statistics/worldstatistics/

2 The Nuclear Energy Institute, http://www.nei.org/resourcesandstats/nuclear_statistics/usnuclearpowerplants

3 The Nuclear Energy Institute, http://www.nei.org/newsandevents/newsreleases/nuclear-industrys-safety-operating-performance-remained-top-notch-in-08-wano-indicators-show

An in-depth discussion

Utilities can successfully manage the size and scope of building nuclear power plants through clear and enforceable governance structures.

Carefully analyzing and accounting for potential project risks is critical during a build

With the length of time between the previous construction cycle and the one today, many utilities are faced with a lack of experience in building new nuclear facilities. This may leave these utilities vulnerable to missing important elements in the strategic planning process that can result in unanticipated changes and lead to expensive change orders and midcourse corrections, poorly conceived contracts, overly aggressive schedules and unanticipated design changes. Most of the engineering standards and regulatory requirements that applied during the last construction cycle are antiquated and obsolete and did not keep up with the changing world of maintenance and new maintenance techniques.

Compounding this is the fact that most of the engineering and construction organizations have similarly lost many of their experienced personnel. Thus, it will be important to carefully analyze and account for as many variables as possible during the planning of these new nuclear units. Because it has been so long since nuclear facilities have been built, utilities, regulators, policy makers and other critical stakeholders (including rate payers) will have to overcome a sizable learning curve, including:

- New financial controls will be required to carefully monitor massive multi-year, multi-billion dollar capital projects. Control initiatives will be complicated by the growing trend of financing nuclear construction projects using complex structures that include multiple owners, investors and perhaps even direct government funding.
- Engineering skills will have to be refreshed to address the specific and sophisticated nuclear facility building and plant operating and maintenance requirements.
- New contract execution and management strategies must be conceived to govern relationships with more sophisticated suppliers, and to help ensure that risks are shared and costs are fixed.
- More vigorous compliance initiatives are needed to meet requirements for enhanced transparency and accountability throughout the entire build-out process.
- New techniques will be required to monitor and manage a global supply chain that procures and ships critical nuclear plant modules and components from remote facilities . . . rather than constructing them on site.
- New engineering standards based on modern engineering and maintenance technologies are urgently required and must be developed in order to ensure that risks are visible and mitigation techniques are deployed.

Financial Opportunities

One of the most striking elements of building new nuclear power plants is the sheer size and scope of these projects. It is estimated that the cost of building a new facility will range between $10 billion and $25 billion. As a result, a discussion about how the capital is going to be raised, monitored, managed—and ultimately recovered—is among the first in a series of large challenges that executives and policy makers must consider.

Since nuclear power is now seen as an important element in the nation's energy policy, the federal government, as a result of the Energy Policy Act of 2005, has made funding available to facilitate the efforts to construct nuclear power facilities.[1] For instance:

- According to the Nuclear Energy Institute (NEI), the act allocates a production tax credit of $18 per megawatt-hour for 6,000 megawatts of new nuclear capacity for the first eight years of operation. The federal government is also offering to reimburse certain debt service for the initial new construction projects, if the project falls behind schedule for reasons beyond the company's control.
- The United States is also making "loan guarantees" available to qualifying utilities to offset some of the risk associated with expensive nuclear plant construction initiatives. While the loan guarantee program is not a subsidy, the program is seen by many as a useful opportunity to lower the cost of capital for new reactors. However, these loan guarantees do come with certain government compliance requirements. Companies that avail themselves of the loan guarantees will be subject to additional scrutiny, management oversight and reporting requirements. As a result, it is possible that some utilities will elect to proceed without this assistance.

In addition to the federal government's seed money, we expect to see more joint ventures and partnerships as utility and power companies develop their nuclear strategies. By partnering, utilities are better able to commit to these capital-intensive projects. Joint ventures and partnerships will allow utilities to spread the risk and capital outlay requirements. For example, Georgia Power Company's (GPC) two new Vogtle units will be jointly owned by GPC and three other local entities. These companies currently own the existing Vogtle units and have established a similar structure for the building and operation of the new units. Similarly, in late 2009, EDF Development Inc. acquired a 49.99 percent interest in Constellation Energy's nuclear subsidiary for $4.5 billion. The focus of this joint venture is on a fleet of existing nuclear plants.[2] At the time the parties agreed to the transaction in December 2008, EDF made a $1 billion cash investment in Constellation Energy and committed to providing additional liquidity support.

Additionally, Constellation Energy and EDF have an existing partnership through their UniStar Nuclear Energy joint venture to build, own and operate new nuclear power plants in the United States. UniStar's first wave of new reactor license applications for four projects was accepted earlier last year and docketed by the Nuclear Regulatory Commission.

Given these trends, PwC expects that most of the new nuclear units will establish some type of partnership with other entities as a way of managing the financial risks that are inherent in such complex and lengthy projects.

1 www.nei.org/filefolder/Financing_New_Nuclear_Plants_January_2009.pdf

2 Constellation Energy, http://ir.constellation.com/releasedetail.cfm?ReleaseID=354780, Dec. 17, 2008

New organizational and procedural framework

Utilities pursuing new nuclear power plant construction will have to go through a dramatic organizational change that will touch every aspect of their operations. Utilities must clearly define position requirements based on the skill sets and experience that are currently available.

Graph 1

But they must also identify gaps in expertise, and develop active plans to address those gaps.

A well-defined organizational framework (see graph 1) outlining responsibilities, authority and accountability will help orchestrate how these disciplines work together to ensure that a project is effectively managed.

It is critical that the project oversight function be carefully staffed and defined. Executives with oversight responsibilities must have experience with developing, managing and enforcing complex governance structures. The oversight team will be responsible for ensuring the metrics managed at a department or disciplinary level translate into strong contributions to the strategic objectives of the construction process.

Because these projects are complex, long-term and large-scale, staff continuity is critical. As people with strong expertise are acquired, and new skills are developed by existing staff, it will be important to have personnel make a shared commitment to see projects through completion. Toward that end, utilities must establish compensation strategies for all staff levels that are competitive and favorably comparable to opportunities for similarly skilled professionals in other industries and other geographic regions.

This issue is especially important during the early phases of the current nuclear renaissance. The existing pool of "nuclear-ready" technical and management personnel is very shallow. Moreover, once these employees are retained, utilities should continue assessing skill set requirement gaps and invest in ongoing skill development training while watching for signs of staff burnout. It is important to capture the knowledge of the expert teams early and retain, assess, share and further develop this knowledge throughout the maturing stages.

As the nuclear facility construction process evolves through the different phases of development, it will be critical for the organizational structure to adapt to new requirements. This will call for the development of a comprehensive and disciplined change management strategy that methodically takes nuclear utilities from their current state of operations to an extremely well-designed future state of operations.

Having defined and effective processes and procedures established and implemented is also a fundamental building block to new nuclear project success. In PwC's view, the following are the key project elements to consider in defining the processes. (see graph 2)

Graph 2

Project life cycle →

Project elements ↑

	Planning	Design	Implementation	Testing	Turnover	M&O
Organization Design & HR Management	Project management plan and staffing			Staff reductions/ transfers	Operations staff planning	Ongoing requirements/ skills review
Procurement & Contract Management	External contracting options	Vendor qualification/ RFP process (EPC contract evaluation)	Vendor selection/ contracting	Contract compliance review	Trouble-shoot & punch list	Vendor qualification/ selection
Scope & Change Management	Definition of project elements and benefits	Design project components (Phase 1 transition plan)	Change control process		User acceptance process	Operations acceptance process
Cost Management	Capital budgeting and ratemaking approach	Cost & schedule forecast	Cost control		Final payment/ retention release	M&O budget process
Schedule Management	Project schedule requirements	Baseline project schedule (WBS & consolidated Pre-deployment schedule)	Detailed schedule management		Schedule completion check list	Ongoing maintenance schedule
Business Systems & Technology	Project purpose funding & approval	Business needs assessment & technology framework	Integration & executive oversight		Continuous improvement and reasonableness reviews	
Risk & Issue Management	Project risk & issue management planning	Risk & issue tracking & resolution			Confirm issue resolution	Ongoing issue management process
Communication, Reporting & Regulatory Requirements	Project reporting requirements (Project communication strategy)	Project status and regulatory filings	Project cost, schedule & budget variance	Project quality performance	Project close-out performance	Financial reporting

Procurement and contract negotiations

Because the nuclear construction environment is specific and the demand for new nuclear facility construction has been increasing rapidly, the balance of power during utility, contractor, and supplier negotiations could initially swing in favor of product and service providers. This will create significant vendor management challenges for construction executives interested in enforcing performance standards that include “shared risk” provisions with suppliers. Although over time a balance will be achieved, it is very important for executives to carefully compose and orchestrate agreements with suppliers, and address shortcomings that commonly emerge during the procurement and contracting process. For instance:

- Many nuclear plant construction contracts reviewed by PwC have omissions that could significantly contribute to the risk profile for the nuclear plant construction project.
- Many agreements today are drafted using language that is not well-defined or mutually understood. Contract terms and conditions are all-too-often vague and fail to clearly define the specific project elements. Poor scope definitions have a common tendency to result in claims and disputes about what was actually agreed upon at what price, and can introduce uncertainty and risk to the cost structure. It is critical for utilities to clearly delineate minimum requirements in contracts and provide detailed descriptions for the scope of work, timeline expectations for start and completion dates, as well as product and process quality requirements.
- PwC has also noted inappropriate application of contract types to different projects in the construction process. Fixed price, and time and materials agreements, for instance, are often inappropriately described and prescribed.

In order to mitigate project contract risks, PwC recommends that utilities establish clear processes and procedures for awarding and managing contracts. In addition, utilities should take a proactive and consistent approach to managing contract risks across vendors and projects.

The process for selecting appropriate vendors and partners is also a function that needs to mature rapidly. If the selection procedures—including request for information (RFI) and request for proposal (RFP) documents—are vague or incomplete, this can yield unclear proposals that contain incomplete or misaligned pricing structures that extend the contract-awarding process beyond its scheduled timelines. PwC recommends that utilities define highly structured solicitation, bidding and evaluation practices and establish disciplined and standardized pre-contract award assessment procedures and interview requirements.

The absence of world-class contract and vendor management practices can lead to significant risk exposure. In the worst scenarios, contractors can find that they have insufficient resources to complete projects on time or meet critical technical requirements.

Execution efficiencies

Today's nuclear supply chains are more complicated than the processes most utilities are accustomed to managing. The combination of this enhanced complexity with a lack of experience that many organizations have in this field, along with projects of this magnitude, represents an important risk that must be managed. The scale and duration of these projects are much larger than those of conventional energy plants, as are the quality, documentation, inspection and testing requirements.

Moreover, construction techniques have evolved significantly. Rather than constructing everything at the site, the development of today's nuclear plants calls for having major modules fabricated off site and then transported to the ultimate construction location.

In many cases this is required because of improvements in design and manufacturing techniques. Plant modules—which in some cases can be several stories high—must be built in highly controlled atmospheres. They are then transported and assembled on site. This not only elevates the importance of transportation and logistics in the current generation of nuclear facilities, but also requires extremely precise planning and coordination between equipment and material deliveries. In many instances, critical components will be manufactured and imported from overseas locations.

While schedule management challenges are not unique to the nuclear industry, the size, scope and high-profile nature of nuclear plants can turn even minor slippages in scheduled activities into a major risk factor that can add billions of dollars in cost—or threaten the viability of project completion entirely.

Failing to install an Integrated Master Schedule (IMS) that is fully embraced by the most senior and influential stakeholders is one of the biggest reasons important milestone dates fail to be achieved. The absence of an operational and properly governed IMS process can lead to limited ability to accurately predict and understand the project performance, including overall project status and individual component history and remaining activity.

The IMS is the basis for developing a consolidated Work Breakdown Structure (WBS) for the project. Without these tools, it is easy to lose track of both time and resources, which leads to confusion and an insufficient level of detail to evaluate work elements.

PwC believes that in order to mitigate schedule risk, utility project teams and executives must establish a baseline IMS that is approved by all key parties before significant project activity begins. This makes it possible to develop a WBS, which provides both a detailed and summary review of all tasks on the critical path.

Mitigating risk can be accomplished in part by placing systems and procedures in place that capture near-real-time information pertaining to planned versus actual schedule status. It is critical that schedule updates are prepared and submitted in compliance with contract terms and conditions. These must be available to key decision makers in real time and prepared in an appropriate format that will ease the transfer between stakeholders.

Optimal EAM strategy

Historically, utilities have not considered implementation of Enterprise Asset Management (EAM) systems and Asset Reliability until the operating teams are hired prior to commissioning. This missed opportunity is substantial in terms of lost data, data rework, plant reliability issues and distractions to the operating team during commissioning and startup. There are three key aspects to consider during the design build phase:

- EAM data
- Asset reliability and maintenance program development
- Early implementation of an EAM system

Designing EAM into the plant during construction will reduce capital costs and allow utilities to achieve desired capacity factors, utilization and performance far earlier in the operating phase, while optimizing asset life-cycle cost and extending asset life. By incorporating these concepts, utilities will reap the benefits once the plants are operational.

What this means for your business

Establishing the right organizational structure and procedural framework will allow executives to effectively identify, manage and mitigate risks.

Enhancing efficiency while establishing effective strategies

As concerns continue to rise about electricity demand and clean air initiatives, utilities around the world are realizing the great promise of new nuclear power plants and making investments today.

In our view, the key to delivering a successful project will revolve around understanding organizational objectives in the new environment, establishing effective strategies that are aligned with these objectives, and ensuring that contracts and project execution tactics follow suit. Success will also be contingent on putting in place effective methods and tools to measure and monitor the status and progress of these highly complex processes and procedures. This cannot be achieved without a strong organizational culture with a clear governance structure that defines and enforces core principles.

Establishing the right organizational structure and procedural framework will allow executives to effectively identify, manage and mitigate risks that could threaten the viability of these immense projects. Effective and comprehensive governance structures are the only way that utilities will be able to carefully track existing and emerging variables so that risks to project completion can be captured and mitigated well before they have an opportunity to materialize. By taking structure and finance and execution into consideration, executives will be more likely to achieve a successful and sustainable outcome.

Nuclear power represents a big opportunity for utilities. While many in the past have been actively discouraged from pursuing the nuclear option because of safety concerns, these concerns have now been refuted as many plants enter their third or fourth decade of safe and reliable operation. The build-out of nuclear power plants represents a major enhancement to the national grid modernization efforts that are taking place throughout the country and reflect national priorities on carbon replacement and the reduction of fossil fuel dependence.

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Contacts

For a deeper discussion of these issues, contact:

David Etheridge
Utilities practice leader
(415) 498-7168
david.etheridge@us.pwc.com

Mark Rauckhorst
Utilities managing director
(678) 419-2087
mark.rauckhorst@us.pwc.com

Daryl Walcroft
Utilities principal
(415) 498-6512
daryl.walcroft@us.pwc.com

Chris Fynn
Utilities principal
(646) 471-1266
christopher.c.fynn@us.pwc.com

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