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## Nuclear Crews Stretch Work, Up Costs

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Recent events underscore the dismal state of nuclear power plant construction in the U.S. Of 35 reactor projects under construction last fall, two have been abandoned, a dozen have raised their cost estimates significantly despite the falling rate of inflation, and nine others have suffered delays or other cost-creating setbacks.

A new comparison of reactor costs around the country suggests that an unforeseen factor has been helping to confound cost-control efforts. I call it the last-plant factor. It is the tendency of contractors and craft workers building a utility's final nuclear project to prolong construction—ad infinitum if possible—to stretch their employment.

The last-plant factor may help explain a number of important facts about the nuclear business, including low labor productivity and "last-minute" licensing difficulties at many U.S. reactor projects, and the relative stability of nuclear costs in France. The last-plant factor also may portend still higher costs for many unfinished plants in the U.S., as well as in other nations whose nuclear programs slow down.

Nuclear plant costs have exploded in just a dozen years. The first U.S. nuclear units completed on a commercial basis in the early 1970s cost under half a billion dollars (all cost figures in this article are adjusted to 1982 prices without interest, for thousand-megawatt plants). This cost was only slightly more than contemporary coal plants, a difference soon paid off through fuel savings. By the end of the 1970s, however, costs had swelled to \$1 billion for newly completed projects. This was considerably more than the cost of coal plants with improved emission controls, and enough to cast serious doubt on new nuclear plants' cost competitiveness.

### More Expensive Electricity

Reactors under construction form another class altogether, ranging to almost \$4 billion and averaging \$2 billion. The average is double that of plants finished only five years ago, and about five times as great in real terms as the first reactors built commercially at the start of the '70s. These high costs virtually guarantee that electricity from brand-new nuclear plants will be far more expensive than prevailing power, even taking future inflation in fossil fuels into account.

What accounts for the tremendous rise in reactor costs? For one thing, increasingly stringent regulation of safety matters by the Nuclear Regulatory Commission has helped multiply the labor, engineering

and material inputs to nuclear plants. Frequent changes in design and construction requirements have also engendered expensive cost-plus contracting arrangements.

Yet the regulatory factor, which undoubtedly was the biggest cause of rising nuclear costs during the 1970s and for a period following the 1979 accident at Three Mile Island, should have diminished of late with less frequent imposition of new safety rules. Moreover, increased regulations alone can't explain the threefold range in current reactor costs.

As a first step toward determining other influences over nuclear costs, I compiled utility cost estimates for three dozen nuclear construction projects. These comprise all projects still being built, along with the several completed last year. I then converted the figures to constant prices to eliminate distortions stemming

from different treatment of financing costs and disparate construction periods. But experience and management may be overrated. Among other utilities, nuclear experience does not correlate statistically with lower costs, perhaps because changing designs and shifting regulatory and political requirements make each project unique. Similarly, it isn't clear that all three utilities have unusually skillful nuclear managements, as indicated by Commonwealth Edison's quality assurance problems and by TVA's recent shutdown of one of its operating reactors to better supervise repair workers. In one key nuclear indicator—plant generating performance—the three have fared no better than their peers.

Where the three utilities may differ from others is lesser susceptibility to the last-plant effect. With two unimportant exceptions, Duke, Commonwealth and TVA have for some time been the only U.S. util-

ities building more than one nuclear project. Many of their construction contractors and craft workers have thus been able to count on further work at subsequent plants. But there is no such guarantee at other utilities' nuclear projects, since each has been the "last available." Only by prolonging the job, through slowdowns, make-work or even misfeasance, can construction personnel ensure that they stay employed.

For this country, the last-plant effect could portend continuing difficulties at many remaining nuclear projects. Exhortations to raise productivity, the last refuge of helpless utility managers and regulators, are likely to fail unless new contractual arrangements and incentives are devised—a tall order at this late stage. For the nuclear industry as a whole, the last-plant effect suggests that continuity may matter as much as management. It could also be a harbinger of other problems, economic as well as safety, that nuclear power will face as its era of growth ends and decline sets in.

### France's Cutbacks

The last-plant effect isn't unique to nuclear power. It can be seen in numerous subway projects, sewer districts, stadiums or other construction jobs that pose difficult engineering problems requiring cost-plus contracting, and where follow-up work is uncertain. What has made it rampant in present-day nuclear construction is the specialized and not readily transportable skills of the craft workers, the umbrella provided by chronic design and regulatory changes, and now the disappearance of new plants from the horizon.

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The seven least-expensive projects, estimated by their builders to cost between \$1 billion and \$1.5 billion, are all owned by Duke Power Co., Commonwealth Edison of Chicago or the Tennessee Valley Authority. Two of the seven projects are almost through their start-up phase, and their estimated costs may be presumed accurate. Costs for the others are subject to change, as Commonwealth Edison discovered in January when it extended its schedules for two nuclear projects after being denied a license to operate one of them. Nevertheless, even after adding 20% to those two projects' real costs, and adjusting all costs for regional wage variations and advantages such as twin-unit plants, Duke, Commonwealth and TVA undercut the industry norm by 30%.

It is tempting to attribute the three utilities' lower costs to their large size, greater nuclear experience and superior management. And it is probably true that their large engineering and construction staffs and political muscle have helped them weave their way through the maze of NRC regulation, as well as deal with engineering contractors, state rate-setting authorities and local political officials, any of whom may have the power to impose costs, whether directly or indirectly.

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