TECHNICAL POSITION PAPER

For

ESTABLISHING AN APPROPRIATE CONTINGENCY FACTOR FOR INCLUSION IN THE DECOMMISSIONING REVENUE REQUIREMENTS

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1.0 EXECUTIVE SUMMARY

1.1 Objective

The purpose of this technical position paper is to determine and apply a conservative contingency factor to Pacific Gas and Electric (PG&E) nuclear facilities Humboldt Unit 3, Diablo Canyon Units 1 and 2, and Southern California Edison (Edison) San Diego Gas and Electric (SDG&E) San Onofre Nuclear Generating Station Units 2 and 3 cost estimates. It was determined in California Public Utility Commission (CPUC) Decision 07-01-003 (Reference 8.1) that further detailed analysis and study is needed before the California Public Utility Commission (CPUC) can adopt reasonable future estimates for contingency factors in the decommissioning cost forecasts.

1.2 Overview of Approach

A three stage investigation approach was taken to assess a reasonable contingency factor for use. First, a literature search on government published reports and guidance on contingency factors was conducted. Second, a search on how the industry applied contingency factors on nuclear (domestic and foreign) and other industries such as fossil-fuel plants, process industries and offshore facilities was conducted. Third, a review of recommended cost engineering practices from established organizations such as the Association for the Advancement of Cost Engineering (AACE) and the American Institute of Cost Engineers and the Construction Industry Institute was assessed.

1.3 Conclusions

A 25 percent contingency factor for all nuclear decommissioning costs should be applied. Though the industry has been inconsistent in how it applies and uses contingency in decommissioning cost estimates, regulatory reports and guidance on contingency factors have generally been consistent, and they recommend that a contingency on the order of 25 percent be applied to a base cost estimate.

Based on an understanding of the level of project definition, and the extent and maturity of estimate input that information is used to develop decommissioning cost estimates, the 25 percent contingency factor is within the range of industry recognized cost engineering practices.

Because decommissioning cost estimates and their contingencies are used to establish rates for collection of revenue into a decommissioning trust fund, they have been litigated numerous times and it is more efficient to establish a definitive and consistent level for CPUC filings. Issuance of this position paper or “white paper” completes the PG&E, Edison and SDG&E commitment to demonstrate that they have made all reasonable efforts to conservatively establish an appropriate contingency factor for inclusion in the nuclear decommissioning revenue requirements.

2.0 INTRODUCTION

Per Reference 8.1, Conclusion from Law item 8, Edison, SDG&E and PG&E shall serve testimony in their next triennial review of nuclear decommissioning trusts and related decommissioning activities that demonstrates they have made all reasonable efforts to conservatively establish an appropriate contingency factor for inclusion in the decommissioning revenue requirements.

2.1 Background

2.1.1 PG&E

Per Reference 8.1, the proposed settlement incorporates a 35% contingency factor for Diablo Canyon and 25% for Humboldt Bay Unit 3. Fielder proposes that PG&E should modify the settlement and use a 40% factor relying primarily on two issues: (1) the adopted contingency has been declining from a high of 50% in 1987 (24 CPUC 2d 15, 20) to 40% in 1995 (63 CPUC 2d 571, 613-614) and now the settling parties propose 35%; and (2) because of the Barnwell closure, waste storage costs are much more uncertain.

2.1.2 Edison and SDG&E

Per Reference 8.1, the Commission should adopt as reasonable the updated decommissioning cost estimates for SONGS 2&3 and Palo Verde set forth by Edison and SDG&E in the Joint Application (other than the revision to the Palo Verde decommissioning cost estimate, reflecting a reduction in the contingency factor for non-LLRW burial components of the cost estimate from 35% to 21%).

2.2 Definitions

2.2.1 American Association of Cost Engineers – Cost Engineers Notebook

Contingency – a specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events that increase costs are likely to occur (Reference 8.12).

2.2.2 AACE International Recommended Practice – Cost Engineering Terminology

Contingency – an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs. Typically estimated using statistical analysis or judgment based on past asset or project experience. Contingency usually excludes: 1) Major scope changes such as changes in end product specification, capacities, building sizes, and location of the asset or project; 2) Extraordinary events such as major strikes and natural disasters; 3) Management reserves; and 4) Escalation and currency effects. Some items, conditions, or events for which the state, occurrence, and/or effect is uncertain include, but are not limited to, planning and estimating errors and omissions, minor price fluctuations (other than general escalation), design developments and changes within the scope, and variations in market and environmental conditions. Contingency is generally included in most estimates, and is expected to be expended (Reference 8.4).

2.2.3 DOE Guidance and Contingency Definition

DOE has elected to narrow the scope of the definition stated in Section 2.2.1, as adopted by the American Association of Cost Engineers, and defines contingency as follows:

Contingency – covers costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of the contingency will depend on the status of the design, procurement, and construction; and the complexity and uncertainties of the component parts of the project. Contingency is not to be used to avoid making an accurate assessment of expected cost.

It is not DOE's practice to set aside contingency for major schedule changes or unknown design factors, unanticipated regulatory standards or changes, incomplete or additions to project scope definition, force majeure situations, or congressional budget cuts. Projects and operations estimates will always contain contingency. Estimators should be aware that contingency is an integral part of the estimate.

3.0 ASSUMPTIONS AND BASES

3.1 Present Technology and Regulatory Changes

A cost estimate is prepared based upon present technology, the latest information available on decommissioning costs and on current federal regulations. There are, however, risks associated with decommissioning, such as regulatory changes. No provision is made to include future changes in costs, for example, due to improvements in technology, major regulatory changes, etc. Contingency dollars are expected to be fully expended throughout the program. Direct testimony of Thomas S. LaGuardia on behalf of Consumers Energy Company (Reference 8.3).

3.2 Escalation and Inflation

Contingency, as used in an estimate, is not intended to cover price escalation and inflation in the costs over the duration of the decommissioning (Reference 8.3).

4.0 TECHNICAL DISCUSSION

4.1 Contingency - What it is - What it is not

The cost elements in a decommissioning cost estimate are based upon ideal conditions where activities are performed within the defined project scope, without delays, interruptions, inclement weather, tool or equipment breakdown, craft labor strikes, waste shipment problems, burial facility waste acceptance criteria changes, changes in the anticipated plant shutdown conditions, etc. However, as with any major project, events occur that are not accounted for in the base estimate. Therefore, a contingency factor is applied per Financial Aspects of Engineering (Reference 8.5).

A contingency factor is meant to account for the difference between the base cost and unforeseen costs. The base cost estimate defines the project scope and accounts for the known and reasonably anticipated costs of decommissioning. A contingency factor, by contrast, is intended to account for any unforeseen costs within the defined project scope; i.e., events that may occur in the field during implementation of the work, and which are not accounted for in the base cost estimate. For example, the breaking of a drill, the mechanical failure of heavy equipment, late deliveries of supplies and equipment, the flooding of a trench, and industrial accidents are all unforeseen events that increase the cost of decommissioning activities. Such costs increases are deemed to be within the scope of the project because they occur during the conduct of an activity that is included in the base estimate. At the same time, they are unforeseeable because no one can predict when equipment will break, an accident will occur, or when the weather will cause delays (Reference 8.2). Contingency is a cost allowance for field-related problems that are likely to occur per testimony of Thomas S. LaGuardia for various fossil fueled power plants (Reference 8.12).

It is important to note that contingency factors do not compensate for all the risks that could increase decommissioning costs. Instead, contingency factors reflect only one type of risk – the specific risks of increased costs resulting from conditions at the project site after the commencement of the decommissioning work. Contingency factors do not reflect other factors that could possibly increase costs, such as escalation rates for low-level radioactive waste disposal and other costs and factors not related to specific project conditions (Reference 8.3).

Because of the uncertainty in contamination levels, waste disposal costs and other costs associated with decommissioning, the base cost estimate is required to apply an “adequate” contingency factor per NRC’s “Draft Guidance on Finacial Assurance for Decommissioning Planning Proposed Rule” (Reference 8.7).

There is a general misconception about the use and role of contingency within decommissioning estimates, in that it is sometimes incorrectly viewed as a “safety factor”. Safety factors provide additional security and address situations that may never occur. In contrast, contingency dollars are expected to be fully expended throughout the program. They also provide assurance that sufficient funding is available to accomplish the intended tasks. An estimate without contingency, or from which contingency has been removed, can disrupt the orderly progression of the work and jeopardize a successful conclusion to the decommissioning process (Reference 8.3).

Past dismantling and decommissioning experiences have shown that problems are likely to occur and may have a cumulative impact. Fossil-fueled and nuclear power plants share some of the same potential problems leading to the need for contingency in cost estimates. These problems areas include (Reference 8.12):

Table 4-1
Typical Decommissioning Problem Areas

Problem Area	Consequence
Schedule Slippages	Leading to crew overtime payments and/or project extensions
Weather Delays	Loss of productivity, overtime, slippages
Labor Strikes	Loss of productivity, slippages
Worker Injuries	Production interruptions, additional safety training, worker compensation claims, possible increased insurance premiums
Material Shipping	Rescheduling of activities, inefficiencies in production, out-of-scope backcharges from subcontractors
Equipment Breakdown	Rescheduling of activities, inefficiencies in production, out-of-scope backcharges from subcontractors
Regulatory Inspections	Insurance inspectors, Occupational Safety and Health Act (OSHA) inspectors, federal and state EPA inspectors, state building inspectors
Hazardous Materials	Special handling requirements beyond planned requirements

4.2 Financial Risks

In addition to the routine uncertainties addressed by contingency, another cost element that is sometimes necessary to consider when bounding decommissioning costs relates to financial risk. Examples can include changes in work scope, pricing, job performance, and other variations that could conceivably, but not necessarily, occur. Consideration is sometimes necessary to generate a level of confidence in the estimate, within a range of probabilities. TLG Services, Inc. (TLG) considers these types of costs under the broad term "financial risk." Included within the category of financial risk are (TLG Cost Study P01-1513-002, Reference 8.8):

- Transition activities and costs: ancillary expenses associated with eliminating 50% to 80% of the site labor force shortly after the cessation of plant operations, added cost for worker separation packages throughout the decommissioning program, national or company-mandated retraining, and retention incentives for key personnel.

- Delays in approval of the decommissioning plan due to intervention, public participation in local community meetings, legal challenges, and national and local hearings.

- Changes in the project work scope from the baseline estimate, involving the discovery of unexpected levels of contaminants, contamination in places not previously expected, contaminated soil previously undiscovered (either radioactive or hazardous material contamination), variations in plant inventory or configuration not indicated by the as-built drawings.

- Regulatory changes, e.g., affecting worker health and safety, site release criteria, waste transportation, and disposal.

- Policy decisions altering national commitments, e.g., in the ability to accommodate certain waste forms for disposition, or in the timetable for such.

- Pricing changes for basic inputs, such as labor, energy, materials, and burial. Some of these inputs may vary slightly, e.g. -10% to +20%; however, burial could vary from -50% to +200% or more.

It has been TLG's experience that the results of a risk analysis, when compared with the base case estimate for decommissioning, indicate that the chances of the base decommissioning estimate being too high is a low probability, and the chances that the estimate is too low is a much higher probability. This is mostly due to the pricing uncertainty for low-level radioactive waste burial, and to a lesser extent due to schedule increases from changes in plant conditions and to pricing variations in the cost of labor (both craft and staff). This cost study, however, does not add any additional costs to the estimate for financial risk since there is insufficient historical data from which to project future liabilities. Consequently, the areas of uncertainty or risk are revisited periodically and addressed through repeated revisions or updates of the base estimate.

5.0 INVESTIGATION

5.1 Regulatory Reports and Guidance on Contingency Factors

5.1.1 Atomic Industrial Forum Final Published Report AIF/NESP-009

In direct testimony (Reference 8.2), Thomas S. LaGuardia stated that in preparing the AIF/NESP study (November 1976), the project developed a base cost estimate to decommission several types of nuclear plants. After arriving at the base cost estimate, they then looked back at the individual elements of the base cost and performed an analysis of potential increases in costs for each area based on unexpected changes. When they compared the number generated from accounting for these cost increases to the base cost, they observed that the overall cost increased anywhere from 13 to 24 percent. In the final published report, the AIF recommended that a contingency on the order of 25 percent be applied to a base cost estimate to account for these changes. The upshot is that a 25 percent contingency factor, now customarily applied to nuclear facility decommissioning cost estimates, was originally developed from experience gained in decommissioning nuclear power plants.

5.1.2 NUREG/CR-0672 Technology, Safety and Cost of Decommissioning a BWR

The total cost for immediate dismantlement of a reference BWR (Table I.3-1 of NUREG/CR-0672 Vol. 2 - June 1980), includes a 25% contingency. This NUREG was prepared by Pacific Northwest Laboratory for the U.S. Nuclear Regulatory Commission.

In direct testimony provided by Thomas S. LaGuardia (Reference 8.2), the basis for this value including an independent assessment by PNL and is stated as follows:

“Around the same time we were preparing the AIF/NESP study, the NRC commissioned Battelle Pacific Northwest Laboratories to study the decommissioning of a pressurized water reactor. At that time, we met with the principal author of the Battelle study for the purpose of seeking an informal peer review of our own cost estimates. When Battelle published its NRC-commissioned report, it also recommended 25 percent as a reasonable contingency factor to add to the total estimated cost for decommissioning a pressurized water reactor. Battelle also was commissioned to prepare a cost estimate to decommission a boiling water reactor, and independently concluded, based on that additional work, that a 25 percent contingency factor was reasonable for power reactors, as well as for other types of nuclear facilities. (e.g., research reactors and fuel cycle facilities).”

5.1.3 NUREG-1757 Consolidated NMSS Decommissioning Guidance

NUREG-1757 (and as used per direct testimony, Reference 8.2) states that because of the uncertainty on contamination levels, waste disposal costs, and other costs associated with decommissioning, the cost estimate should apply a contingency factor of 25 percent to the sum of all estimated decommissioning costs. The 25 percent contingency factor provides reasonable assurance for unforeseen circumstances that could increase decommissioning costs, and should not be reduced or eliminated simply because foreseeable costs are low.

Notably, NUREG-1757 (page A-32) further states (and as used per direct testimony, Reference 8.2): "NRC's recommendation for the use of a 25 percent contingency factor is consistent with the analysis and guidance contained in NUREG/CR-6477, which applies a 25 percent contingency factor to all estimated costs associated with decommissioning various reference facilities."

5.1.4 IAEA-TECDOC-1476 Financial Aspects of Decommissioning

The 2005 IAEA report by an expert group (Reference 8.5) states that early decommissioning cost estimates included a contingency of 25% that was applied to the total project cost. More recent and accurate approaches apply contingencies on a line-item basis, yielding a weighted average contingency for the cost estimate. One source for the line-item contingencies is the AIF/NESP study AIF/NESP-036, Atomic Industrial Forum (Reference 8.6).

5.1.5 Draft NRC Guidance on Financial Assurance for Decommissioning Planning

The recent 2008 USNRC draft guidance (Reference 8.7) states that, in general, a contingency of 25 percent applied to the sum of all estimated decommissioning costs should be adequate, but in some cases a higher contingency may be appropriate. The 25 percent contingency factor provides a reasonable assurance for unforeseen circumstances that could increase decommissioning costs, and should not be reduced or eliminated simply because foreseeable costs are low. Proposals to apply the contingency only to selected components of the cost estimate, or to apply a contingency lower than 25 percent, should be approved only in circumstances when a case-specific review has determined that there is an extremely low likelihood of unforeseen increases in the decommissioning costs (e.g., if the decommissioning costs are highly predictable and are established by binding contracts).

5.1.6 DOE Order 5700.2, Cost Estimating, Analysis, and Standardization

Per Reference 8.19, the application of contingency for various types of cost estimates covers the entire life cycle of a project from feasibility studies through execution to closeout. The contingency guidelines have been adopted by the DOE estimating community and should be incorporated into the operating procedures of DOE and operating contractor project team members.

Table 5-1 presents the contingency allowances by type of construction estimate for the seven standard DOE estimate types.

Table 5-1
DOE Contingency Allowance Guide by Type of Estimate

Type of Estimate	Overall Contingency Allowances % of Remaining Costs Not Incurred
PLANNING (Prior to CDR) Standard Experimental/Special Conditions	 20% to 30% Up to 50%
BUDGET (Based upon CDR) Standard Experimental/Special Conditions	 15% to 25% Up to 40%
TITLE I	10% to 20%
TITLE II DESIGN	5% to 15%
GOVERNMENT (BID CHECK)	5% to 15% adjusted to suit market conditions
CURRENT WORKING ESTIMATES	See Table 11-2 of Reference 8.19
INDEPENDENT ESTIMATE	To suit status of project and estimator's judgment

A nuclear decommissioning cost estimate type can be considered to be budgetary. From Table 5-1, it is equivalent to a DOE Budget type between a Conceptual Design Report (CDR) being done (15% to 25%) and a standard estimate up to 40%. Within DOE, the CDR produces the technical, schedule, and cost baselines that will be approved and updated by the change control process through to the start of operations. Therefore, application of a 25% contingency is consistent with DOE contingency guidance and would start at the upper end of a budget type estimate supported by a CDR at 25%.

5.1.7 Canadian Financial Guarantees for the Decommissioning of License Activities

The Canadian Nuclear Safety Commission (CNSC) operates within a legal framework that includes law and supporting regulatory documents. Law includes such legally enforceable instruments as acts, regulations, licenses and directives. Regulatory documents such as policies, standards, guides, notices, procedures and information documents support and provide further information on these legally enforceable instruments. Together, law and regulatory documents form the framework for the regulatory activities of the CNSC.

Regulatory Guide G-206, Financial Guarantees for the Decommissioning of Licensed Activities, provides guidance regarding the establishment and maintenance of measures to fund the decommissioning of activities licensed by CNSC.

Application of a 23% contingency factor to five Canadian plants is discussed in more detail in Section 5.3.2.

5.2 Industry Use and Application of Contingency Factors

5.2.1 Louisiana Energy Services (LES), L. P. National Enrichment Facility (NEF)

In a prefiled direct testimony by Rod M. Krich (RMK) and Thomas S. LaGuardia (TSL) dated September 2005 on behalf of Louisiana Energy Services, L.P. regarding the adequacy of the contingency factor applied by LES to its cost estimate for depleted uranium disposition (Reference 8.2), an overall contingency factor of 25 percent was addressed. RMK testified, as an expert, that the 25 percent contingency factor that LES explicitly committed to apply to its overall commercial cost estimate for depleted uranium ("DU") dispositioning is appropriate and reasonable, insofar as the use of the 25 percent contingency factor is consistent with NRC Staff's recommendation in NUREG-1757 (Vol. 3, App. A. at A-29).

TSL testified, as an expert, that the 25 percent contingency factor applied by LES to its DU dispositioning cost estimate is fully adequate, in view of: (1) the NRC Staff's specific recommendation in NUREG-1757 that materials licensees apply a contingency factor of 25 percent to the sum of all estimated decommissioning costs, and (2) the nature of the facility to be decommissioned (an enrichment facility as opposed to a nuclear power plant) and the radioactive waste (depleted uranium) to be dispositioned by LES.

In response to a question as to whether the application of a "flat" 25 percent contingency factor to LES's overall DU dispositioning cost estimate raised any concerns...that is, is a more detailed or line-item type estimate of the type prepared for facility decommissioning necessary?, the following testimony was provided:

(TSL) "No. For the reason discussed above, I believe that the 25 percent factor applied by LES is more than adequate. To be sure, with respect to more complex projects, such as the decommissioning of a nuclear power plant, contingencies are likely to be estimated on a line-item basis. That is, the estimator breaks down each activity, such as decontamination, removal, packaging, shipping, and disposal, and assigns a recommended contingency to each discrete activity. For example, in the case of nuclear power plant decommissioning, project management is assigned a relatively low contingency factor (on the order of 15 percent), whereas reactor vessel segmentation is assigned a very high contingency factor (on the order of 75 percent). The need for such high contingency factors, as it exists for reactor vessel segmentation, will not exist for the LES facility. In any event, substantial "real-world" experience has shown that when such contingencies are individually "costed" out and averaged, the result is an overall contingency of no more than 25 percent. Thus, it is certainly reasonable to apply a one-time or "across the board" contingency factor of 25 percent to the comparatively much simpler activities associated with DU dispositioning, i.e., DU deconversion, transportation, and disposal."

"In addition, extensive historical experience in decommissioning nuclear power plants has shown that 25 percent is an appropriate contingency for those more complex types of facilities. In other words, experience teaches that considerable margin is inherent in the use of a 25 percent contingency factor, even for decommissioning projects that involve activities substantially more complex than those associated with the dispositioning of DU."

This conclusion is also reached in Section 5.2.2 and 5.2.3.

5.2.2 Consumers Energy Company Palisades Nuclear Plant

In direct testimony dated June 2004 on behalf of Consumers Energy Company, Thomas S. LaGuardia (TSL) stated that past decommissioning experience has shown that unforeseeable elements of cost are likely to occur in the field and may have a cumulative impact. In the AIF/NESP-036 Guidelines Study (Chapter 13), referred to earlier, TLG examined the major activity-related problems (decontamination, segmentation, equipment handling, packaging, shipping and burial) with respect to reasons for contingency. Individual contingencies ranged from 10% to 75% of the related base cost depending on the degree of estimating difficulty judged to be appropriate from our actual decommissioning experience. The overall contingency, when applied to the appropriate components of the Palisades estimate, results in an average of approximately 20%. This is a reasonable contingency level given the nature of the estimate and should be included in the total cost estimate for planning purposes" (Reference 8.3).

5.2.3 PG&E Humboldt Bay Unit 3

Contingency funds are an integral part of the total cost to complete the decommissioning process. Exclusion of this component puts at risk successful completion of the intended tasks and, potentially, subsequent related activities. For the cost study conducted in 2005 (Reference 8.8), TLG examined the major activity-related problems (decontamination, segmentation, equipment handling, packaging, transport, and waste disposal) that necessitate a contingency. Individual activity contingencies ranged from 10% to 75%, depending on the degree of difficulty judged to be appropriate from TLG's actual decommissioning experience. The contingency values used in the 2005 cost study are as follows:

Table 5-2
Line-by-Line Contingency Factors

Category	Humboldt Bay Unit 3 (BWR)	Arkansas Nuclear One (PWR)
Decontamination	50%	50%
Contaminated Component Removal	25%	25%
Contaminated Component Packaging	10%	10%
Contaminated Component Transport	15%	15%
Low-Level Radioactive Waste Disposal	25%	25%
Reactor Segmentation	75%	75%
NSSS Component Removal	25%	25%
Reactor Waste Packaging	25%	25%
Reactor Waste Transport	25%	25%
Reactor Vessel Component Disposal	50%	50%
GTCC Disposal	15%	15%
Non-Radioactive Component Removal	15%	15%
Heavy Equipment and Tooling	15%	15%
Supplies	25%	25%
Engineering	15%	15%
Energy	15%	15%
Characterization and Termination Surveys	30%	30%
Construction	15%	15%
Taxes and Fees	10%	10%
Insurance	10%	10%
Staffing	15%	15%
ISFSI-related expenditures	20%	---

For Humboldt, the contingency values are applied to the appropriate components of the estimate on a line item basis. A composite value is then reported at the end of the estimate. The composite contingency value reported for this estimate is 17.4% (Reference 8.8).

For Arkansas Nuclear One, the overall contingency, when applied to the appropriate components of the estimate on a line item basis, resulted in a range between 17% and 20% for Scenarios 1 through 3 (Reference 8.9).

In accordance with practices in prior GRCs and the 2002 NDCTP, PG&E has removed the contingency factor applied by TLG to the cost estimates for Humboldt Unit 3 (17.4 percent) and has applied a more general, overall, contingency factor that applies to all costs and addresses not only engineering uncertainties, but also financial, regulatory, and industry uncertainties. In the 2002 NDCTP, the Commission authorized an overall contingency factor of 25 percent. In Decision 03-10-014, the Commission states, “the

proposed use of the engineering contingency factors estimated by TLG as the overall contingency factor does not address all of the contingencies the contingency factor is intended to cover." Therefore, the Commission did not limit the overall contingency factor to the engineering contingency factors; rather the Commission adopted a 25 percent contingency factor. Consistent with the Commission's findings, PG&E proposes the continued use of the same level of contingency (25 percent) that was previously adopted by the Commission in the 2002 NDCTP decision.

Maintaining this level of contingency accommodates the increasingly uncertain regulatory and business environment in which the decommissioning will be performed. For example, the estimate of the cost of disposal for LLRW assumes $200 per cubic foot disposal, which is significantly less than the current disposal rates for non-Atlantic Compact generators at the Barnwell, South Carolina facility. Similar uncertainty and risks surround the burial costs of greater-than-Class C (GTCC) radioactive waste. Given the continuing controversy over the site selection of a federal facility to receive GTCC wastes (i.e., Yucca Mountain, Nevada) and the present uncertainty of the availability of this facility, this contingency factor will provide some assurance that sufficient funds will have been collected should these costs increase at a greater-than-expected rate or should PG&E be forced to explore other remedies to dispose of radioactive waste.

With the 25 percent contingency factor, the decommissioning costs for Humboldt Unit 3, stated in 2004 dollars, are approximately $352.7 million.

5.2.4 Ontario Power Generation

The Canadian Nuclear Safety Commission (CNSC) staff reported that Ontario Power Generation Inc. (OPG) applied contingency factors to its base cost estimates. For decommissioning and long term waste management programs, the contingency factor averages 23% over the base cost estimates. For the smaller operations component of the estimates, which is based upon existing experience, the contingency factor is applied at an average rate of 10% over the base cost estimates. CNSC staff stated that these contingency factors are acceptable and consistent with CNSC Regulatory Guide G-206 (Reference 8.10).

5.2.5 Fossil-Fueled Power Plants

Direct testimony was given by Thomas S. LaGuardia presenting the results of a decommissioning, i.e., dismantling cost study prepared by TLG, for the following fossil-fueled power plants (Reference 8.12):

Table 5-3
Fossil-Fueled Power Plants Considered in TLG's Cost Study

Station	No. of Units	Megawatts (per Unit)
Albright	3	97 MWe
Fort Martin	2	555 MWe
Harrison	3	640 MWe
Hatfield	3	553 MWe
Paul Smith	2	58 MWe
Pleasants	2	621 MWe

An extensive discussion of nuclear contingency is included in the AIF/NESP-036 Guidelines Study. In that study, individual contingencies ranged from 10% to 75%, depending on the degree of difficulty judged to be appropriate from our actual decommissioning experience. The overall contingency, when applied to the appropriate components of nuclear plant decommissioning costs, results in an average contingency of up to 25%. For fossil plant dismantling, the absence of radioactive materials and their attendant potential problems simplifies the dismantling process. Individual activity contingency estimates for fossil-fueled power plants are usually in the range of 15%.

Independent of their preparation of the estimate for Allegheny Power, R.S. Means, "Building Construction Cost Data 1997," suggests that a 15% contingency factor for conventional construction be used. This is consistent with the 14% average included by TLG in the estimates for the Allegheny Power stations.

5.2.6 Inappropriate Application of Contingencies

Pennsylvania Power & Light Company's Pennsylvania base rate proceeding at Docket No. R-00943271 was the Pennsylvania Public Utility Commission's most recent opportunity to review a utility's decommissioning cost estimate prepared by TLG. In that case, the Commission did not accept the inclusion of a contingency in the decommissioning expense approved for the Susquehanna Steam Electric Station (Reference 8.12).

The Pennsylvania Pubic Utility Commission (Pennsylvania PUC) adopted the Administrative Law Judge's (ALJ's) recommendation to disallow the contingency, although for reasons different than those offered by the ALJ. The ALJ characterized the contingency as a "safety factor" that may or may not be required. The Pennsylvania PUC, in its Order and Opinion dated September 27, 1995, equated contingency with the uncertainty in "evolving costs" over the funding lifetime. That is, they assumed that the contingency was included to reflect the forces that would drive increases in basic decommissioning costs in the future. Therefore, they recommended that "periodic cost updates should be substituted for the use of a one-time contingency factor."

Per testimony by Thomas S. LaGuardia, both the ALJ and the Pennsylvania PUC deviated from the definition and application of contingency as stated within the cost estimates developed by TLG for the Susquehanna SES. The ALJ interpreted contingency as a "safety factor." Rather, contingency funds are an integral part of the base estimate and are expected to be fully expended throughout the program. Absent the contingency, there is a significant probability that sufficient funding would not be available to accomplish the intended tasks. If expenses are accrued on the basis of an estimate without contingency, or from which contingency has been removed, the orderly progression of events in the decommissioning process can be disrupted and the financial success of the project can be jeopardized.

5.2.7 Offshore Facility Decommissioning Costs

A benchmark outside the power industry was sought and decommissioning of offshore facilities within the oil and gas industry was chosen. Per Reference 8.13, the Pacific OCS Region (POCSR) Offshore Facility Decommissioning Cost Team (OFDC) was formed to develop cost estimates for decommissioning offshore oil and gas facilities in

the POCSR. This cost report covers operator compliance with Outer Continental Shelf (OCS) oil and gas regulations (30 CFR 250 and 256) for permanent plugging of wells; removal of well conductors and platform jackets to 15 feet below the mudline; decommissioning and removal of platform decks; decommissioning and removal of pipelines and power cables as appropriate; site clearance; and other lease and permit requirements. The report is one of the inputs used by the POCSR to determine if a Supplemental Bond is required from a lessee.

Platform decommissioning costs can vary widely due to factors such as location and type (complexity) of the facility, number of structures to be removed, water depth and weight associated with the structure, the number and depth of wells and conductors, removal method, and transportation and disposal options. Although water depth and weight (size) are key variables in determining the decommissioning costs for any particular activity, other factors may have significant impact on the decommissioning cost. For example, the costs of plugging and abandoning a well with deviation greater than 60 degrees will be much greater than the cost of plugging and abandoning a well with no deviation. Similarly, the cost of decommissioning a pipeline that must be removed will be much greater than the cost of decommissioning a pipeline that is approved to be abandoned in-place.

A 20% general contingency factor is applied to cover unanticipated problems and potential cost overruns. The general contingency is not applied to the mobilization and demobilization portion of the decommissioning cost. In addition, a weather contingency of 10% or 20% is applied depending on the location of the platforms.

5.2.8 Public Utility Commission of Texas

The Public Utility Commission of Texas proposed an amendment to sec.23.21, concerning the cost of service component of nuclear decommissioning funds. The proposed amendment makes two changes to the current rules. The amendment establishes a contingency factor of 25% to be used in establishing an electric utility's cost of service. The commission's intent in adopting a 25% contingency factor was to decide the issue through rulemaking so that the issue will not be litigated in future proceedings. Furthermore, the commission intends for the 25% contingency factor to be controlling in all prospective proceedings involving nuclear decommissioning trusts (Reference 8.11).

In 1992 (Reference 8.15), the Public Utility Commission of Texas (the “Commission”) adapted an amendment to establish a contingency factor of 10% to be used in establishing an electric utility’s cost of service and required a utility to provide a copy of the decommissioning study and any redetermination to the Commission’s Electric Division.

El Paso Electric Company and Texas Utilities Electric Company supported the establishment of a 25% contingency factor. El Paso Electric Company commented that the rule would allow for a consistent basis for establishing decommissioning costs between the Texas utilities; reduce litigation costs; provide the ability to adjust the contingency factor on a timely basis in the future; and, provide consistency with FERC and other state's findings on decommissioning. Texas Utilities comments were similar to those of El Paso Electric Company. It added that the rule would reduce rate case

expenses, shorten the hearings, and remove one item from the issues that the commission must decide.

Central Power and Light Company (CPL), the City of El Paso, the Office of Public Counsel (OPC), and Texas Industrial Energy Consumers commented that the commission should not establish a 25% contingency factor. Instead, their comments stated that the factor is a factual issue that should be determined on a case-by-case basis. Office of Public Counsel, the City of El Paso, and Texas Industrial Energy Consumers stated that the industry is relatively inexperienced in decommissioning nuclear units, and as experience is gathered the cost estimates should become better. The Office of Public Utility Counsel and the City of El Paso also stated that the estimates are dependent on such factors as the type of reactor that is in place, whether the estimate is site specific, and the method of decommissioning the unit. Texas Industrial Energy Consumers (TIEC) and the City of El Paso commented that the rule currently provides for a decommissioning study with the best available estimates to be filed every five years. Because such studies provide the best available estimate for decommissioning, a contingency factor was unnecessary. CPL stated that in order to assure adequate funding the contingency factor should be determined on a case-by-case basis.

The Commission disagreed with these comments. The definition and purpose of the contingency factor is different from that assumed by these comments. The majority of the utilities in Texas use TLG to perform the decommissioning studies for the nuclear units. Thomas S. LaGuardia consistently recommends a 25% contingency factor, and justifies the contingency factor on the basis of force majeure type occurrences. He cites situations such as adverse weather causing delay in the shipment of waste; tool breakdown; material delivery delays due to adverse weather; material shortages; production problems; shipping damage; scheduling of manpower due to illness; variability of individual productivity; work stoppages or strikes; material removal delays; and changing regulatory requirements.

These types of occurrences do not change depending on the type of unit involved, the type of study performed, or the method of decommissioning anticipated to be used. Furthermore, experience gained in the industry over time will not impact these types of factors. The Commission strongly believes that it is of utmost importance that the funds to decommission the nuclear plants that are regulated by the Commission be in place at the time that decommissioning begins. Force majeure occurrences should be anticipated and funds established to pay for such occurrences.

OPC also stated that there is no unanimity to the amount of the contingency factor. Different amounts have been argued in dockets by various parties and the commission has established differing levels. TIEC also states that the rule would be inconsistent with a recent rate case ruling.

The Commission agreed that it has established differing levels for the contingency factor for the different utilities under its jurisdiction. The Commission also agreed with El Paso Electric Company's comments that the rule will provide needed consistency between the utilities regulated by the commission. As previously stated, the factor is included in rates in anticipation of force majeure type occurrences. Such occurrences do not change drastically between differing utilities. Therefore, the Commission believes that it is in the public interest to establish the factor through rule.

OPC also stated that the rule will not reduce litigation costs and that there must be a factual basis in the rulemaking for the establishment of a 25% contingency factor. TIEC stated that the current ratepayers are shouldering the burden of high capital costs for the nuclear plants with which future ratepayers will not have to be burdened. Therefore, future ratepayers should have to shoulder future burdens of decommissioning if the funds are found to be lacking because the burden of rate base is less.

The Commission believes that the establishment of the factor through rule will reduce litigation costs. After a review of the rate cases that utilities have filed since the request for inclusion of the nuclear power plants in rates, the issue has been litigated in every docket. Many times the contingency factor was the sole issue litigated on the decommissioning study. While large amounts of time have not been spent on the subject, there has been time and effort spent by the parties, general counsel, the hearings division, and the commissioners on the issue. Because the issue is basically the same for each docket, it is more efficient to establish a definitive level.

OPC's comment that there is no factual basis in this proceeding for establishing a contingency factor is without merit. Rulemaking is a legislative function that does not require an evidenciary record as in the case of a contested proceeding. The rulemaking procedure is one that allows the Commission to establish policy and use all information before it in the process. The Commission has considered a number of dockets in which the level of the contingency factor was an issue, so it is familiar with the issue.

As to the level of the contingency factor, the Commission believed at the time that 10% was the appropriate level. This level would provide more security in having adequate funds for decommissioning. The money contributed cannot be spent by the utilities, but instead would be maintained in external, irrevocable trusts. Based on current information, the Commission still believes 10% to be the appropriate level.

As re-stated in Reference 8.16 (dated 2004), the Transferee Company shall periodically perform, or cause to be performed, a study of the decommissioning costs of each Texas jurisdictional nuclear generating unit it owns or in which it leases an interest. A study or re-determination of the previous study shall be performed at least every five years, starting from the date of the most recent decommissioning cost study for the plant on file with the Commission. The study or re-determination shall consider the most current and reasonably available information on the cost of decommissioning. A copy of the study or re-determination along with an updated funding analysis shall be filed with the Commission and copies provided to the Commission's Financial Review Division and the Office of Public Utility Counsel. The funding analysis shall be based on the most current information reasonably available for the cost of decommissioning, an allowance for contingencies of 10% of the cost of decommissioning, the balance of funds in the decommissioning trusts, anticipated escalation rates, the anticipated after-tax return on the funds in the trust, and other relevant factors. The funding analysis shall be accompanied by a description of the assumptions used in the analysis and shall calculate the required annual funding amount necessary to ensure sufficient funds to decommission the nuclear generating plant at the end of its useful life.

5.2.9 New Hampshire Seabrook Decommissioning Proceedings

The New Hampshire law on Nuclear Decommissioning was originally enacted in 1981 to assure that adequate resources would be available to decommission the Seabrook Nuclear Power Plant. The law created a Committee with the responsibility of establishing a decommissioning fund for each nuclear generating facility in the state, and it requires the Committee to hold public hearings to receive information on funding requirements for each fund. The following is a summary on applying contingency factors as outlined in Reference 8.17 on three proceedings of the Committee that were completed in 1989, 1992 and 1995:

First Proceeding of the Committee (1988 – 1989)

There were two major issues for the Committee to decide: the amount of the fund to be established and the amount of the regular monthly payments into the fund to reach the amount established. The fund assumed a prompt dismantling of the plant and included a 25% contingency to address operational problems.

Second Proceeding (1990 – 1992)

DECON ought to be assumed to be the method of dismantling and a reduction from a 25% to a 21% contingency factor was appropriate based on the line item contingency analysis done by TLG Services.

Third Proceeding (1993 – 1995)

The Committee accepted the Company's proposed contingency factor of 17%. The Committee, at the urging of some of the parties, required that the parties develop a recommended schedule for a more in-depth analysis and recommendations to the Committee with regard to an appropriate escalation factor and an appropriate contingency factor and that the parties try to agree on the contents of future updates to the study.

Lessons Learned

As discussed in Reference 8.17, the author states that another lesson to be learned is that because there is still much uncertainty about waste disposal costs, which many people seemed to think would have been resolved by now or would be closer to being resolved, the decision makers are not so likely to adopt or stick with the proposals put forward by companies unless there is a sufficient contingency built in to address this situation. The more uncertainty there is, the higher the contingency factor that may be necessary. Contingency factors will therefore continue to be important issues in these kinds of proceedings.

5.3 Accepted Cost Engineering Practices

5.3.1 AACE International Recommended Practice No. 18R-97

As a recommended practice of AACE International (Reference 8.18), the Cost Estimate Classification System provides guidelines for applying the general principles of estimate classification to project cost estimates (i.e., cost estimates that are used to evaluate, approve, and/or fund projects). The Cost Estimate Classification System maps the phases and stages of project cost estimating together with a generic maturity and quality matrix, which can be applied across a wide variety of industries.

The addendum to the generic recommended practice provides guidelines for applying the principles of estimate classification specifically to project estimates for engineering, procurement, and construction (EPC) work for the process industries. The term process industries is assumed to include firms involved with the manufacturing and production of chemicals, petrochemicals, and hydrocarbon processing.

The addendum specifically does not address cost estimate classification in nonprocess industries such as commercial building construction, environmental remediation, transportation infrastructure, “dry” processes such as assembly and manufacturing, “soft asset” production such as software development, and similar industries.

However, Reference 8.18 provides a good reference point or benchmark to another industry. Keep in mind that the confidence in any estimate focuses on its primary scope defining documents in determining the level of project definition, and thus the extent and maturity of estimate input information. The complexity and magnitude of a large engineering, procurement, and construction (EPC) project is similar to decommissioning a nuclear site.

The five estimate classes are presented in Table 5-4 in relationship to the identified characteristics. Only the level of project definition determines the estimate class. The other four characteristics are secondary characteristics that are generally correlated with the level of project definition, as discussed in the generic standard. The characteristics are typical for the process industries but may vary from application to application.

Table 5-4
Cost Estimate Classification Matrix for the Process Industries

	Primary Characteristic	*Secondary Characteristic*			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]	**PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/ Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

Notes: [a] The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.
[b] If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

Ref. AACE International Recommended Practice No. 18R-97

When comparing nuclear decommissioning to process industries cost estimates, the estimate class is equivalent to Class 3 as shown in Table 5-4 and explained in Table 5-5. That is, Class 3 estimates are generally prepared to form the basis for budget authorization, appropriation, and/or funding. Class 3 estimates are typically prepared to support full project funding requests, and become the first of the project phase "control estimates" against which all actual costs and resources will be monitored for variations to the budget. By definition of Class 2 and Class 4 estimates, nuclear decommissioning estimates reasonably fall between these classes and their use is consistent with the definition of Class 3. Therefore, application of a 25% contingency is within the high range variation of +10% to + 30%.

Table 5-5
Class 3 Estimate Definition and Examples

Description: Class 3 estimates are generally prepared to form the basis for budget authorizations, appropriation, and/or funding. As such, they typically form the initial control estimate against which all actual costs and resources will be monitored. Typically, engineering is from 10% to 40% complete, and would comprise at a minimum the following: process flow diagrams, utility flow diagrams, preliminary piping and instrument diagrams, plot plan, developed layout drawings, and essentially complete engineered process and utility equipment lists. **Level of Project Definition Required:** 10% to 40% of full project definition. **End Usage:** Class 3 estimates are typically prepared to support full project funding requests, and become first of the project phase "control estimates" against which all actual costs and resources will be monitored for variations to the budget. They are used as the project budget until replaced by more detailed estimates. In many owner organizations, a Class 3 estimate may be the last estimate required and could well form the only basis for cost/schedule control.	**Estimating Methods Used:** Class 3 estimates usually involve more deterministic estimating methods than stochastic methods. They usually involve a high degree of unit cost line items, although these may be at an assembly level of detail rather than individual components. Factoring and other stochastic methods may be used to estimate less-significant areas of the project. **Expected Accuracy Range:** Typically accuracy ranges for Class 3 estimates are –10% to –20% on the low side, and +10% to +30% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Effort to Prepare (for US$20MM project):** Typically, as little as 150 hours or less to perhaps more than 1500 hours, depending on the project and the estimating methodology used. **ANSI Standard Reference Z94.2-1989 Name:** Budget estimate (typically –15% to +30%). **Alternate Estimate Names, Terms, Expressions, Synonyms:** Budget, scope, sanction, semi-detailed, authorization, preliminary control, concept study, development, basic engineering phase estimate, target estimate.

Ref. AACE International Recommended Practice No. 18R-97

5.3.2 American Institute of Cost Engineers and the Construction Industry

The American Institute of Cost Engineers and the Construction Industry Institute have established guidelines and procedures for estimating costs. These guidelines as delineated in Table 5-6 rank cost estimates as grades A, B or C depending on their level of accuracy.

"Grade A" estimates are the most accurate and therefore require the smallest associated "contingency allowance" (10%). "Grade C" estimates are considered to be the least accurate and consequently require a contingency allowance of 25% to 30%. "Grade B" estimates are of intermediate accuracy requiring a contingency allowance of 15% to 20%.

Per Reference 8.14, estimates should include unit costs for each phase of the decommissioning plan, and should be prepared in accordance with generally accepted accounting and quantity-surveying methods and procedures. These estimates should accurately reflect local construction rates for labor and materials, should be sufficiently detailed as to demonstrate accuracy and facilitate independent verification, and should assume that the work will be completed by competent independent contractors.

Table 5-6
Determination of "Grade" of Estimate and Contingency Allowance

Grade C (+/- 25% to 30%) These estimates are generally performed quickly by using short cut techniques, such as escalating and/or scale up from previous estimates, cost curves, and/or preliminary process design and equipment sizing, without plot plans or major equipment quotations.
Grade B (+/- 15% to 20%) These estimates can be developed for large projects as soon as the preliminary process flow diagrams, preliminary plot plans, and equipment sizing have been completed. On smaller projects, some 10% of the engineering should be completed.
Grade A (+/- 10%) These estimates are known as "definitive cost estimates". A "grade A" estimate cannot be developed for a large project until the engineering flow diagrams, plot plans, and equipment lists are completed, and detailed design has progressed to the stage required for the bidding process. For small projects, more engineering detail is necessary, and 30% to 50% of the engineering may be required to be completed.

Per Reference 8.14, the applicant should indicate the grade of the estimate and include the appropriate contingency allowance in the total cost estimate. The Canadian Nuclear Safety Commission (CNSC) staff reported that Ontario Power Generation Inc. (OPG) applied contingency factors to its base cost estimates. For decommissioning and long term waste management programs, the contingency factor averages 23% over the base cost estimates. For smaller operations components of the estimates the contingency factor is applied at an average rate of 10% over the base cost estimates, which is based upon existing experience. CNSC staff stated that these contingency factors are acceptable and consistent with CNSC Regulatory Guide G-206 (Reference 8.10).

OPG stated that it prepared cost estimates for the five Nuclear Generating Stations (Pickering A, Pickering B, Darlington, Bruce A and Bruce B), used fuel management, low and intermediate level waste management, and the three waste management facilities (Pickering, Western and Darlington). In its submission, OPG detailed the cost estimates for the decommissioning of these facilities.

OPG stated that the cost estimate for the five Nuclear Generating Stations takes into account a unit cost factor based on actual project experience. The cost estimate also takes into account the application of work difficulty factors, which recognize site-specific conditions in addition to factors related to radiation protection.

Therefore, application of a 25% contingency is consistent with an average contingency of 23% that was applied to OPG's five plants. It is slightly higher than the "Grade B" estimates which are of intermediate accuracy requiring a contingency allowance of 15% to 20%.

6.0 Analysis of Results

6.1 Industry Use and Application of Contingency

The industry has been inconsistent in how it applies and uses contingency in decommissioning cost estimates. There are even notable contentions in the industry where a contingency factor too low was questioned or not applied. For example, both Nuclear Information and Resource Service NIRS/Public Citizen and the Attorney General of New Mexico have challenged Louisiana Energy Services' (LES) original proposal to use a 10% contingency factor in its cost estimate for the decommissioning of the National Enrichment Facility (NEF). Subsequently, LES committed to use a 25% contingency factor, as provided in NUREG-1757, in its cost estimate for the decommissioning of the NEF (Reference 8.2).

Numerous state public utility commissions have adopted a 25% contingency for nuclear plant decommissioning, as evidenced by an American Gas Association-Edison Electric Institute Depreciation Committee Survey, which showed that at least 21 of 32 utility survey respondents had included a 25% contingency in their estimates. The survey also showed that of the 15 utilities who filed rate cases, 11 had approved of use the 25% contingency for their plant decommissioning studies (Reference 8.12).

The New Hampshire Seabrook plant went through three proceedings that were completed in 1989, 1992 and 1995 as described in Section 5.2.9. Contingency factors were reduced from 25% to 21% and 17%, respectively (Reference 8.17).

The Public Utility Commission of Texas differs by adapting an amendment that establishes a contingency factor of 10%. Also, the Commission believes that the establishment of the factor through rule making will reduce litigation costs. After a review of the rate cases that utilities have filed since the request for inclusion of nuclear power plants in rates, the issue has been litigated in every docket. Many times the contingency factor was the sole issue litigated on the decommissioning study. While large amounts of time have not been spent on the subject, there has been time and effort spent by the parties, general counsel, the hearings division, and the commissioners on the issue. Because the issue is basically the same for each docket, it is more efficient to establish a definitive level (Reference 8.15).

The Pennsylvania Public Utility Commission (Pennsylvania PUC) disallowed the use of a contingency factor on Susquehanna Steam Electric Station. The Pennsylvania PUC equated contingency with the uncertainty in "evolving costs" over the funding lifetime. That is, they assumed that the contingency was included to reflect the forces that would drive increases in basic decommissioning costs in the future. Therefore, they recommended that "periodic cost updates should be substituted for the use of a one-time contingency factor" (Reference 8.12).

Per testimony given by Thomas S. LaGuardia, the Pennsylvania PUC deviated from the definition and application of contingency as stated within the cost estimates developed by TLG for the Susquehanna SES. Absent the contingency, there is a significant probability that sufficient funding will not be available to accomplish the intended tasks (Reference 8.12).

6.2 Nuclear Contingency Factor of 25% versus 14% for Fossil Power Plants

The difference in the contingency factor that is applied to nuclear and fossil power plants is appropriate when considering the radioactive component of nuclear power plants. Removal of radioactively contaminated piping, components and structures from a nuclear plant is more difficult and costly than for comparable items from a fossil plant. The activities of decontaminating, removing, packaging, shipping and burying radioactive materials from a nuclear plant require strict radiological controls, special containments and packaging, and licenses for the transport for disposal. There are many more opportunities for problems to arise in nuclear decommissioning than in fossil plants. Fossil plants have no radioactivity, and so dismantling is comparable to reverse construction. There are fewer potential hazards for the worker and so productivity is higher overall than for nuclear plants, and the overall potential for problems is lower. (Reference 8.12).

As discussed in Thomas S. LaGuardia's testimony, the nuclear contingency is generally in the range of 20-25%. The Federal Energy Regulatory Commission (FERC) adopted a 25% contingency for nuclear power plant decommissioning as reasonable, following the ruling of Judge Liebman in the Middle South Energy/Grand Gulf Case (Docket ER82-616) decision issued February 3, 1984 (Reference 8.12).

6.3 Declining Contingency

A declining contingency, if properly determined, could reflect the improved accuracy of the decommissioning estimates based on more industry experience and being closer to the need for decommissioning. A contingency has an effect in early years of acting like an accelerated funding by over-accruing contributions in addition to its intended purpose of protecting against errors and unforeseen costs in the decommissioning estimate. However, such an approach should not be applied. Case in point, PG&E's HBPP decommissioning cost estimate increased by approximately 20% within a few years of starting and prior to the last cost update. Significant changes to the cost estimate included:

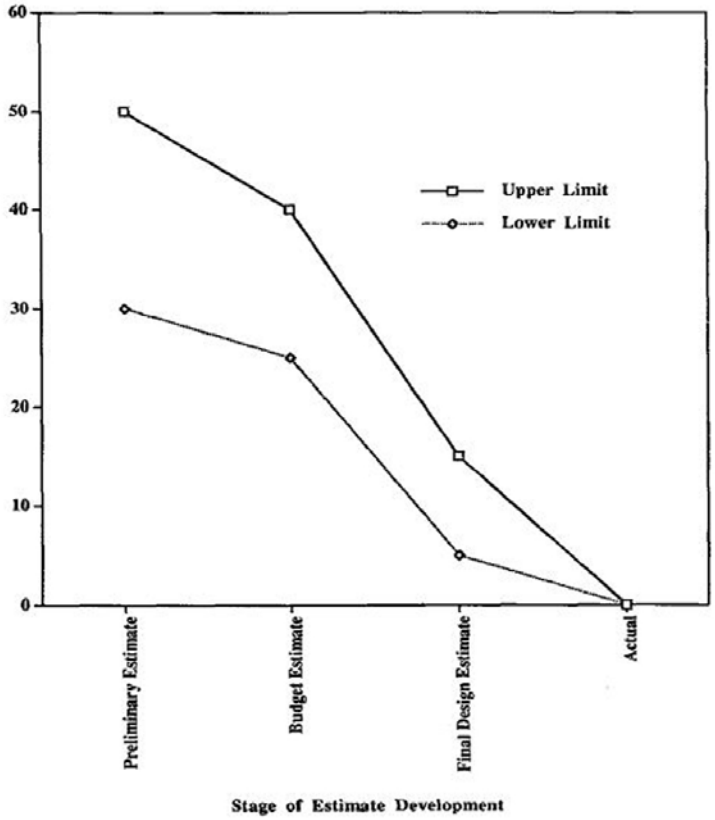
- PG&E and contractor staffing levels were revised based upon an in-depth PG&E review of their staffing needs during the project.
- The unit cost factors for mechanical cutting of components with internal contamination were revised to incorporate stabilization of internal contamination prior to cutting the component. This change was made based upon actual component cutting experience at Humboldt Bay over the past year.
- Changes were made to the work difficulty factors for system and structure removal based upon PG&E's detailed review of radiological conditions and recent Humboldt Bay work experience.
- Costs for additional work activities were added based upon detailed engineering reviews and planning. For example, cost elements were added for the complete removal of the spent fuel pool concrete walls (3), and costs were added for the stabilization and bulk removal of the yard pipe tunnel.

- Increased radioactive waste shipping and disposal costs because of changes in both the quantity of contaminated material and low level radioactive waste disposal rates.

Figure 5-1 depicts the upper and lower limits of contingency over the various stages of estimate development. Base on an understanding of the level of project definition, and the extent and maturity of estimate input information that are used to develop decommissioning cost estimates, these estimates are not likely to mature any further (i.e., permitting, detail engineering, work packages, sampling, characterization, etc.) than budgetary estimates. Therefore, a declining contingency is not a reasonable approach to take as evidenced by HBPP's experience. The HBPP average contingency was about 17% in the 2005 cost estimate and the overall increase in the 2009 estimate to the baseline cost was about 20%.

There also exists too much overall uncertainty to refine contingency for each cost element as done in Table 5-2. If the reactor vessel contingency is 75%, then cost estimating and planning efforts should focus on better defining the duration and cost based upon industry experience. A nine month segmentation of the reactor vessel was changed to reflect an 18 month duration based upon Rancho Seco and NASA Plumbrook experiences and the base cost contingency of 25% was applied.

Figure 5-1
Contingency as a Function of Project Life



Ref. DOE Order 5700.2

7.0 CONCLUSIONS AND RECOMMENDATIONS

A 25 percent contingency factor for all decommissioning costs should be applied. Though the industry has been inconsistent in how it applies and uses contingency in decommissioning cost estimates, regulatory reports and guidance on contingency factors have generally been consistent, and they recommend that a contingency on the order of 25 percent be applied to a base cost estimate.

Based on an understanding of the level of project definition, and the extent and maturity of estimate input information that is used to develop decommissioning cost estimates, the 25 percent contingency factor is within the range of industry recognized cost engineering practices.

Because decommissioning cost estimates and their contingencies are used to establish rates for collection of revenue into a decommissioning trust fund, they have been litigated numerous times and it is more efficient to establish a definitive and consistent level for CPUC filings. Issuance of this position paper or “white paper” completes the PG&E, Edison and SDG&E commitment to demonstrate that they have made all reasonable efforts to conservatively establish an appropriate contingency factor for inclusion in the decommissioning revenue requirements.

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8.10 Record of Proceedings, Including Reasons for Decision, In the Matter of Ontario Power Generation Inc., Financial Guarantee and Licence Amendment for OPG's Class I Nuclear Facility Licences in Ontario, November 1, 2007

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8.16 Title 16, Economic Regulation, Part 2. Public Utility Commission of Texas, Chapter 25. Substantive Rules Applicable to Electric Service Providers, Subchapter L. Nuclear Decommissioning, 16 TAC 25.303.

8.17 A Summary of Nuclear Decommissioning in New Hampshire, Douglas L. Patch, New Hampshire Public Utilities Commission

8.18 AACE International Recommended Practice No. 18R-97, Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries, dated February 2, 2005.

8.19 Department of Energy (DOE) Order 5700.2 Cost Estimating, Analysis, and Standardization, DOE G 430.1-1, dated March 28, 1997

ATTACHMENT A

Examples of Contingency from Past Decommissioning Programs

Excerpts from
Pacific Gas and Electric Company Chapter 6
Humboldt Bay Power Plant Nuclear Decommissioning Cost Study

The following list contains examples of contingencies from past decommissioning programs which increased the costs for decontamination and dismantling tasks.

1. **Incomplete or Changed Conditions**
    - Unavailable and incomplete operational history which led to a recontamination of a work area, as in the case of a sealed cubicle incorrectly identified as being non-contaminated that was breached without controls;
    - Surface coatings covering contamination that, due to an incomplete characterization, required additional cost and time to remediate;
    - Additional decontamination, controlled removal and disposition of previously undetected (although at some sites, suspected) contamination due to enhanced access of formerly inaccessible areas and components; and
    - Unrecorded construction modifications, facility upgrades, maintenance, enhancements, etc., which precipitated scheduling delays, more costly removal scenarios, additional costs (e.g., for re-engineering, shoring, structural modifications) and compromised worker safety.

2. **Adverse Working Conditions**
    - Lower than expected productivity to prevent heat exhaustion in underground vaults, resulting in a change in the working hours (shifting to cooler periods of the day) and additional manpower; and
    - Confined space, low-oxygen environments where supplied air was necessary and additional safety precautions prolonged the time required to perform required tasks.

3. Maintenance, Repairs and Modifications

- Facility refurbishment required to support site operations, including those needed to provide new site services as well as to maintain the integrity of existing structures;
- Damage control, repair and maintenance from bird fouling of equipment and controls;
- Building modification, i.e., re-supporting of floors to enhance loading capacity for heavily shielded casks;
- Upgrading on-site roadways to handle heavier and wider loads, roadway rerouting, excavation and reconstruction;
- Requests for additional safety margins by a vendor;
- Requests to analyze accident scenarios beyond those defined by the removal scenario (requested by the NRC to comply with "total scope of regulation");
- Additional collection and processing of site run-off due to disturbance of natural site contours and drainage;
- Concrete coring for removal of embedments and internal conduit, piping and other potentially contaminated material not originally identified;
- Modifications required to respond to higher than expected worker exposure, water clarity, water disassociation and hydrogen generation from high temperature cutting operations; and
- Additional waste containers needed to accommodate cutting particulates, inefficient waste geometries and excess material.

4. Labor

- Turnover of personnel, e.g., craft and health physics. Replacement of labor is costly, involving additional training, badging, medical exams and associated processing procedures. Recruitment costs are incurred for more experienced personnel and can include relocation and living compensation.
- Additional personnel required to comply with NRC mandates and requests.
- Replacement of personnel due to non-qualification and/or incomplete certification (e.g., welders).

5. Schedule

- Schedule slippage due to a conflict in required resources, e.g., the licensee was forced into a delay until prior (non-licensee) commitments of outside resources were resolved;
- Weather-related delays in the construction of facilities required to support site operations (with compensation for delayed mobilization made to vendor); and
- Rejection of material by NRC inspectors, requiring refabrication and causing program delays in activities required to be completed prior to initiating decommissioning operations.

6. Weather

- Frozen crane hydraulics prior to a major lift; and
- Destruction of an exterior asbestos containment enclosure due to violent winds.

Although not included within the application of the contingency, the factors listed below have an equal probability of affecting the cost and performance of the decommissioning program:

- Transition activities and costs: ancillary expenses associated with eliminating the remaining site labor force shortly after the cessation of decommissioning activities. Added cost for worker separation packages throughout the decommissioning program, state mandated retraining and retention incentives for key personnel.
- Delays in approval of the decommissioning plan due to intervention, public participation in local advisory committees, state and local hearings, etc.
- Regulatory changes, such as those affecting worker health and safety, site release criteria, waste transportation and waste disposal.
- Policy decisions altering federal and state commitments, e.g., in the ability to accommodate certain waste forms for disposition, or in the timetable for such.