COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

THE APPLICATION OF LOUISVILLE GAS AND	**)**	
ELECTRIC COMPANY FOR CERTIFICATES OF	**)**	
PUBLIC CONVENIENCE AND NECESSITY AND	**)**	
APPROVAL OF ITS 2016 COMPLIANCE PLAN	**)**	**CASE NO. 2016-00027**
FOR RECOVERY BY ENVIRONMENTAL	**)**	
SURCHARGE	**)**	

LOUISVILLE GAS AND ELECTRIC COMPANY

RESPONSE TO THE
COMMISSION STAFF'S SECOND REQUEST FOR INFORMATION

DATED APRIL 8, 2016

FILED: APRIL 20, 2016

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF JEFFERSON)

The undersigned, **John N. Voyles, Jr.**, being duly sworn, deposes and says that he is the Vice President, Transmission and Generation Services for Louisville Gas and Electric Company and Kentucky Utilities Company and an employee of LG&E and KU Services Company, that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

John N. Voyles, Jr.
John N. Voyles, Jr.

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 20th day of April 2016.

Judy Schooler (SEAL)
Notary Public

My Commission Expires:

JUDY SCHOOLER
Notary Public, State at Large, KY
My commission expires July 11, 2018
Notary ID # 512743

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) SS:
COUNTY OF JEFFERSON)

The undersigned, **Gary H. Revlett**, being duly sworn, deposes and says that he is Director – Environmental Affairs for LG&E and KU Services Company, and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

Gary H. Revlett
Gary H. Revlett

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 20th day of April 2016.

Judy Schooler (SEAL)
Notary Public

My Commission Expires:
JUDY SCHOOLER
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LOUISVILLE GAS AND ELECTRIC COMPANY

Response to Commission Staff's Second Request Dated April 8, 2016

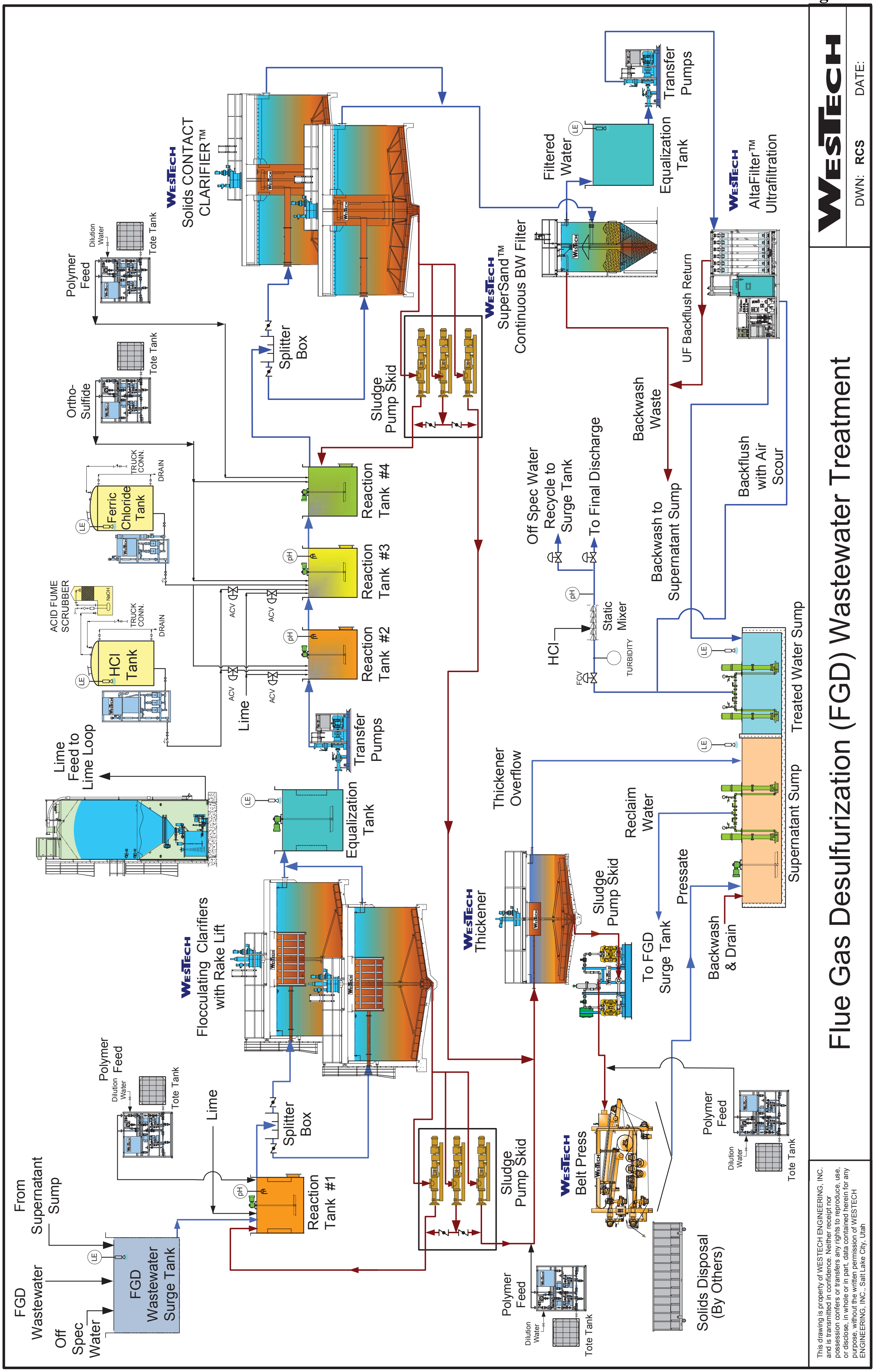
Case No. 2016-00027

Question No. 1

Witness: John N. Voyles, Jr.

Q-1. Refer to the Direct Testimony of John N. Voyles ("Voyles Testimony"), page 18, lines 18-22, concerning process water system construction. Explain in detail whether process water systems are constructed of individually designed components on site, or whether appropriate package systems are available for purchase and installation.

A-1. The process-water systems will be a station-specific design based on the volume of specific process-water streams to be treated. Designs will incorporate as much commonality of processes between all stations as possible, and will likely include a combination of individually designed and sized components and packaged sub-systems to meet the needs of that generating station's specific constituents and permitted discharge limits. See attached for one sample process-water system (generic illustration of water treatment technologies) that contains individually designed components and packaged sub-systems provided by potential technology vendor WesTech.


Flue Gas Desulfurization (FGD) Wastewater Treatment
WESTECH
DWN: RCS
DATE:
FGD Wastewater
Off Spec Water
From Supernatant Sump
FGD Wastewater Surge Tank
LE
Reaction Tank #1
pH
Lime
Polymer Feed
Dilution Water
Tote Tank
Splitter Box
Sludge Pump Skid
WESTECH Flocculating Clarifiers with Rake Lift
Equalization Tank
Transfer Pumps
Lime Feed to Lime Loop
Reaction Tank #2
Reaction Tank #3
Reaction Tank #4
ACV
HCl Tank
ACID FUME SCRUBBER
NaOH
TRUCK CONN.
DRAIN
Ferric Chloride Tank
Ortho-Sulfide
WESTECH Solids CONTACT CLARIFIER™
WESTECH SuperSand™ Continuous BW Filter
Filtered Water
Off Spec Water Recycle to Surge Tank
To Final Discharge
HCl
Static Mixer
TURBIDITY
FCV
Backwash Waste
Backwash to Supernatant Sump
UF Backflush Return
WESTECH AltaFilter™ Ultrafiltration
Backflush with Air Scour
Treated Water Sump
Supernatant Sump
WESTECH Thickener
Thickener Overflow
Reclaim Water
Pressate
To FGD Surge Tank
Backwash & Drain
WESTECH Belt Press
Solids Disposal (By Others)

The ***SuperSand™ Filter*** employs a backwash rise that is performed continually while the tank is processing water. An air lift pump located at the center of the module draws the media from the bottom of the filter up into the wash box. As the media is released into the wash box, it falls into the sand scrubber where the filtered solids are separated from the sand. From there, the filtrate carries the solids out as waste. The washed sand falls down into the media bed for continued use.

Flue Gas Desulfurization (FGD), Wet Scrubber, Wastewater Treatment

Flue gas desulfurization removes sulfur dioxide from fossil fuel flue gases. Wet-scrubbing transfers the pollutants to a liquid which is treated before waterway discharge. The scrubbing solution is usually lime and a concentrated solution of calcium sulfate is produced. Blowdown is required to keep the solution below saturation so that scaling does not occur.

5 Steps of FGD Wastewater Treatment

1. pH Elevation / Metal & Gypsum Desaturation

Desaturating the stream of metals and gypsum is important to prevent scaling on equipment and is performed by dilution and lowering the temperature (remember that calcium salts are inversely soluble). The pH of the wastewater stream is then raised to between 8-10 using calcium hydroxide ($Ca(OH)_2$) or sodium hydroxide (NaOH). Dissolved metals form hydroxides which precipitate as solids.

The lime or caustic is added to precipitate gypsum from the stream. Sludge is recycled from the downstream clarifier to provide seed for gypsum crystallization.

2. Heavy Metal Removal

Some heavy metals are removed as hydroxides as pH is raised. Small waste stream pH adjustment is normally accomplished through caustic addition rather than lime slurry. The use of caustic saves capital costs and reduces sludge production.

Organosulfides or sodium sulfides may be added to further precipitate heavy metals. Metal sulfides have much lower solubility than metal hydroxides. These compounds are also very effective in removing mercury down to parts per trillion levels.

3. Coagulation / Polymer / pH Adjustment

Ferric chloride is added to neutralize charged particles, allowing flocs to form and enhancing clarifier performance. This may also precipitate other metals and organic matter. Polymer addition aids in larger floc formation, further enhancing clarifier performance. The wastewater is clarified by a WesTech Flocculating Clarifier. A rake lift is provided since inlet solids can be as high as 2%. The pH is adjusted to normal using hydrochloric acid (HCL). HCL is used because no additional sulfate needs to be added.

4. Solids CONTACT CLARIFIER™

The metal precipitates must now be removed from the waste stream. Since there is a relatively low amount of solids, it is necessary to use a Solids CONTACT CLARIFIER™ for this purpose. The Solids CONTACT CLARIFIER™ has an impeller-driven sludge recycle stream. This draws sludge from the tank bottom through a draft tube into the reaction well. This impeller acts as a high flow, low shear pump. The recycle stream is sized to 10 times the inlet flow and has suspended solids of 10,000 ppm. Incoming particles contact previously flocculated solids, yielding high removal rates. Blowdown sludge from the Solids CONTACT CLARIFIER™ is recycled to a mix tank in the feed stream. This promotes additional floc formation and solids removal.

Gravity media filtration may be used if a low suspended solids level is required prior to wastewater discharge. In this case, filter backwash is returned to the front of the wastewater treatment system.

5. Solids Dewatering

The clarifier sludge typically contains 3-5 weight percent of solids. This contains inert material and precipitated metals which are pumped to a thickener to increase the solids percentage. Volume dewatering requirements determine the choice of recessed chamber filter presses or belt presses.

LOUISVILLE GAS AND ELECTRIC COMPANY

Response to Commission Staff's Second Request Dated April 8, 2016

Case No. 2016-00027

Question No. 2

Witness: John N. Voyles, Jr.

Q-2. Refer to the Voyles Testimony, the Exhibits prepared by CH2M HILL, Inc. Typically, it is stated that the cost estimates for the studies are +30 percent/-30 percent, and include a 30 percent contingency. Confirm that the 30 percent contingency is in the total capital cost before applying the +30 percent/-30 percent high and low factors.

A-2. The Commission's assumption is correct. The typical "Total Initial Costs," as shown on the Cost Summary page of the CH2M Hill, Inc. reports, includes 30 percent contingency. The 30 percent contingency line-item is located on the cost-estimate spreadsheets and is applied to line-item estimates developed by CH2M. This is typical for all the cost estimates. The +30 percent/-30 percent is then applied to the Total Initial Costs to reflect the accuracy of conceptual costs estimates.

The 30 percent level of contingency is in line with the level of engineering performed (up to 5% of engineering effort) to develop the costs estimates. Using generally accepted industry practices and AACE Internal Cost Estimate Classification System (see attached), the conceptual cost estimates provided are considered Class 4 "Study or Feasibility." The accuracy of Class 4 cost estimates can range from minus 15-30 percent to plus 20-50 percent. CH2M and LG&E agreed to use +30 percent/-30 percent for the estimates in the Exhibits. As project development and further engineering proceed, the level of contingency and cost-estimate accuracy will be refined.

Please see Section 5 of each of the Exhibits from the CH2M for additional details related to the level of engineering effort and the accuracy of the cost estimates.

AACE International Recommended Practice No. 18R-97

COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE PROCESS INDUSTRIES

TCM Framework: 7.3 – Cost Estimating and Budgeting

Rev. March 1, 2016

Note: As AACE International Recommended Practices evolve over time, please refer to www.aacei.org for the latest revisions.

Contributors:

Disclaimer: The opinions expressed by the authors and contributors to this recommended practice are their own and do not necessarily reflect those of their employers, unless otherwise stated.

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COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE PROCESS INDUSTRIES

TCM Framework: 7.3 – Cost Estimating and Budgeting

March 1, 2016

PURPOSE

As a recommended practice of AACE International, 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 project scope definition maturity and quality matrix, which can be applied across a wide variety of process industries.

This addendum to the generic recommended practice (17R-97) provides guidelines for applying the principles of estimate classification specifically to project estimates for engineering, procurement, and construction (EPC) work for the process industries. This addendum supplements the generic recommended practice by providing:

- A section that further defines classification concepts as they apply to the process industries.
- A chart that maps the extent and maturity of estimate input information (project definition deliverables) against the class of estimate.

As with the generic recommended practice, the intent of this addendum is to improve communications among all of the stakeholders involved with preparing, evaluating, and using project cost estimates specifically for the process industries.

The overall purpose of this recommended practice is to provide the process industry with a project definition deliverable maturity matrix that is not provided in 17R-97. It also provides an approximate representation of the relationship of specific design input data and design deliverable maturity to the estimate accuracy and methodology used to produce the cost estimate. The estimate accuracy range is driven by many other variables and risks, so the maturity and quality of the scope definition available at the time of the estimate is not the sole determinate of accuracy; risk analysis is required for that purpose.

This document is intended to provide a guideline, not a standard. It is understood that each enterprise may have its own project and estimating processes and terminology, and may classify estimates in particular ways. This guideline provides a generic and generally acceptable classification system for process industries that can be used as a basis to compare against. This addendum should allow each user to better assess, define, and communicate their own processes and standards in the light of generally-accepted cost engineering practice.

INTRODUCTION

For the purposes of this addendum, the term “process industries” is assumed to include firms involved with the manufacturing and production of chemicals, petrochemicals, and hydrocarbon processing. The common thread among these industries (for the purpose of estimate classification) is their reliance on process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) as primary scope defining documents. These documents are key deliverables in determining the degree of project definition, and thus the extent and maturity of estimate input information.

Estimates for process facilities center on mechanical and chemical process equipment, and they have significant amounts of piping, instrumentation, and process controls involved. As such, this addendum may apply to portions of other industries, such as pharmaceutical, utility, water treatment, metallurgical, converting, and similar industries.

This addendum specifically does not address cost estimate classification in non-process industries such as commercial building construction, environmental remediation, transportation infrastructure, hydropower, “dry” processes such as assembly and manufacturing, “soft asset” production such as software development, and similar industries. It also does not specifically address estimates for the exploration, production, or transportation of mining or hydrocarbon materials, although it may apply to some of the intermediate processing steps in these systems.

The cost estimates covered by this addendum are for engineering, procurement, and construction (EPC) work only. It does not cover estimates for the products manufactured by the process facilities, or for research and development work in support of the process industries. This guideline does not cover the significant building construction that may be a part of process plants.

This guideline reflects generally-accepted cost engineering practices. This RP was based upon the practices of a wide range of companies in the process industries from around the world, as well as published references and standards. Company and public standards were solicited and reviewed, and the practices were found to have significant commonalities. These classifications are also supported by empirical process industry research of systemic risks and their correlation with cost growth and schedule slip[8].

COST ESTIMATE CLASSIFICATION MATRIX FOR THE PROCESS INDUSTRIES

A purpose of cost estimate classification is to align the estimating process with project stage-gate scope development and decision making processes.

Table 1 provides a summary of the characteristics of the five estimate classes. The maturity level of project definition is the sole determining (i.e., primary) characteristic of class. In Table 1, the maturity is roughly indicated by a percentage of complete definition; however, it is the maturity of the defining deliverables that is the determinant, not the percent. The specific deliverables, and their maturity or status are provided in Table 3. The other characteristics are secondary and are generally correlated with the maturity level of project definition deliverables, as discussed in the generic RP [2]. The post sanction classes (Class 1 and 2) are only indirectly covered where new funding is indicated. Again, the characteristics are typical and may vary depending on the circumstances.

	Primary Characteristic	***Secondary Characteristic***		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** 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
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
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%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Table 1 – Cost Estimate Classification Matrix for Process Industries

This matrix and guideline outline an estimate classification system that is specific to the process industries. Refer to the generic estimate classification RP[1] for a general matrix that is non-industry specific, or to other addendums for guidelines that will provide more detailed information for application in other specific industries. These will provide additional information, particularly the project definition deliverable maturity matrix which determines the class in those particular industries.

Table 1 illustrates typical ranges of accuracy ranges that are associated with the process industries. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically to achieve a 50% probability of project overrun versus underrun) for given scope. Depending on the technical and project deliverables (and other variables) and risks associated with each estimate, the accuracy range for any particular estimate is expected to fall into the ranges identified (although extreme risks can lead to wider ranges).

In addition to the degree of project definition, estimate accuracy is also driven by other systemic risks such as:

- Level of non-familiar technology in the project.
- Complexity of the project.
- Quality of reference cost estimating data.
- Quality of assumptions used in preparing the estimate.
- Experience and skill level of the estimator.
- Estimating techniques employed.
- Time and level of effort budgeted to prepare the estimate.
- Unique/remote nature of project locations and the lack of reference data for these locations.
- The accuracy of the composition of the input and output process streams.

Systemic risks such as these are often the primary driver of accuracy, especially during the early stages of project definition. As project definition progresses, project-specific risks (e.g. risk events) become more prevalent and also drive the accuracy range[3]. Another concern in estimates is potential pressure for a predetermined value that may result in a biased estimate. The goal should be to always have an unbiased and objective estimate. The stated estimate ranges are dependent on this premise and a realistic view of the project.

Failure to appropriately address systemic risks (e.g. technical complexity) during risk analysis impacts the resulting probability distribution of the estimate costs, and therefore the interpretation of estimate accuracy.

Another way to look at the variability associated with estimate accuracy ranges is shown in Figure 1. Depending upon the technical complexity of the project, the availability of appropriate cost reference information, the degree of project definition, and the inclusion of appropriate contingency determination, a typical Class 5 estimate for a process industry project may have an accuracy range as broad as -50% to +100%, or as narrow as -20% to +30%.

Figure 1 also illustrates that the estimating accuracy ranges overlap the estimate classes. There are cases where a Class 5 estimate for a particular project may be as accurate as a Class 3 estimate for a different project. For example, similar accuracy ranges may occur if the Class 5 estimate of one project that is based on a repeat project with good cost history and data and, whereas the Class 3 estimate for another is for a project involving new technology. It is for this reason that Table 1 provides ranges of accuracy range values. This allows application of the specific circumstances inherent in a project, and an industry sector, to provide realistic estimate class accuracy range percentages. While a target range may be expected of a particular estimate, the accuracy range is determined through risk analysis of the specific project and is never pre-determined. AACE has recommended practices that address contingency determination and risk analysis methods.

If contingency has been addressed appropriately, approximately 80% of projects should fall within the ranges shown in Figure 1. However, this does not preclude a specific actual project result from falling inside or outside of the bands shown in Figure 1 indicating the expected accuracy ranges.

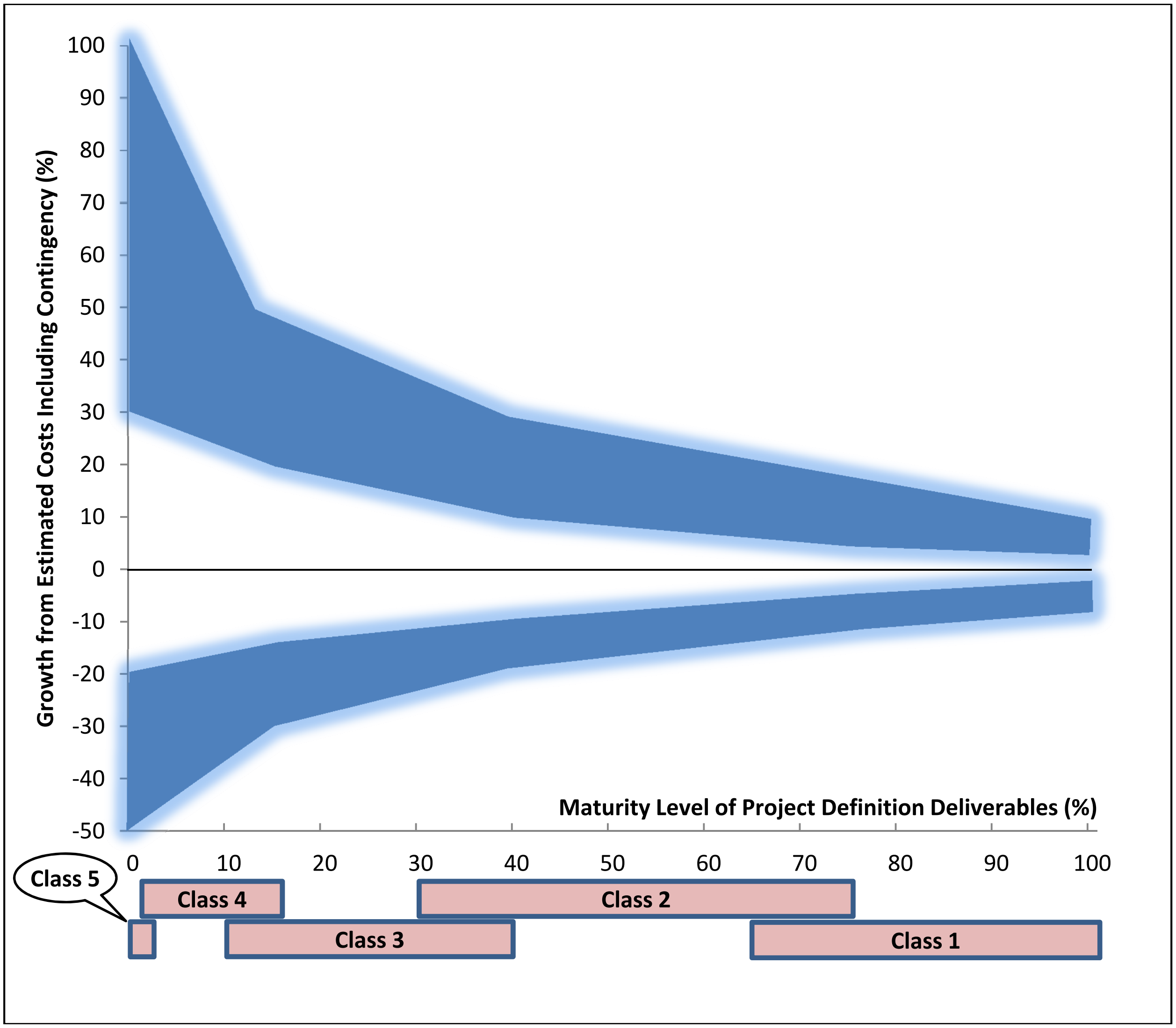

Figure 1 – Example of the Variability in Accuracy Ranges for a Process Industry Estimate

DETERMINATION OF THE COST ESTIMATE CLASS

The cost estimator makes the determination of the estimate class based upon the maturity level of project definition based on the status of specific key planning and design deliverables. The percent design completion may be correlated with the status, but the percentage should not be used as the estimate class determinant. While the determination of the status (and hence the estimate class) is somewhat subjective, having standards for the design input data, completeness and quality of the design deliverables will serve to make the determination more objective.

LOUISVILLE GAS AND ELECTRIC COMPANY

Response to Commission Staff's Second Request Dated April 8, 2016

Case No. 2016-00027

Question No. 3

Witness: Gary H. Revlett

Q-3. Refer to LG&E's response to the Attorney General's Initial Request for Information, Items 6 and 7. The response to Item 7 states that the closure process must be completed in five years. Based on the response to Item 6, if the circumstances are applicable, can extensions to the five-year limit be requested and given?

A-3. No. The response to Item 6 recognized that an extension could be "requested," but in light of the self-implementing nature of the CCR Rule, there is no agency or entity to which such a "request" could be tendered, much less approved. From a practical standpoint, the Company would have to document internally the need for an extension and proceed to defend its position if challenged as if it had been granted. But using such an extension, even if the Company believed it met the applicable criteria, would expose the Company, and ultimately its customers, to additional citizen-suit risk. Because the CCR Rule is self-implementing, citizen suits are the CCR Rule's only enforcement mechanism; relying on additional provisions of the rule, such as the extension provisions, opens the Company to additional avenues of citizen-suit attack.