

1 Q. **Reference: Schedule 1, Page 28, lines 21 to 23.**

2 Hydro reviewed the project scope in detail and assigned potential low and high
3 percentages to individual estimate items, as shown in Attachment 11. These
4 percentages were then used in an MCS- based QRA to develop a cumulative
5 distribution curve from which a contingency value is calculated.

6 a) Does the assigned potential low and high percentages to individual estimate items conform with
7 Range Estimating as described in AACE Recommended Practice No. 41R-08 Risk Analysis and
8 Contingency Determination Using Range Estimating?

9 b) Explain how these high and low estimates were determined and what exactly they represent.

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12 A. a) The Association for the Advancement of Cost Engineering (“AACE”) Recommended Practice
13 (“RP”) 41R-08 *Risk Analysis and Contingency Determination using Range Estimating*, released
14 in 2008, was the first RP developed for Quantitative Risk Analysis (“QRA”). The title of RP
15 41R-08 was changed in 2022 to *Understanding Estimate Ranging*. The 2008 version of the
16 RP was a practitioner guide for a single QRA methodology, which was the method generally
17 in use at the time. The 2022 version is a higher level evaluation document that recommends
18 a shift to other, more risk-driven methods covered in the newer suite of RPs, which were
19 published around the same time as the new version. As stated in the 2022 version of RP
20 41R-08, “The RP now describes and provides considerations for a general class of estimate
21 ranging quantitative risk analysis (QNRA)¹ methods. It also directs to other estimate ranging
22 references and QNRA methods.”²

¹ AACE is attempting to shift terminology from QRA to QNRA (Quantitative Risk Analysis) and QLRA (Qualitative Risk Analysis) in an attempt to reduce confusion, as the generic term QRA can be used for both qualitative and quantitative processes.

² Association for the Advancement of Cost Engineering (2022). Recommended Practice 41R-08 *Understanding Estimating Ranging*.

1 Along with the expanding library of RPs on the practice of QRA, AACE has also published
2 Professional Guidance Document (“PGD”) 02 to aid practitioners in the application of QRA
3 approaches and methods.

4 As stated in the revised AACE RP 41R-08,

5 Estimate ranging can be considered a general class of QNRA methods that
6 involve assigning distributions (i.e., ranges) to estimate elements for some
7 uncertainties and risks at some level of detail and applying MCS to obtain a cost
8 distribution(s) from which cost contingency and reserve determinations can be
9 made and expected estimate accuracy range information provided to decision
10 makers.³

11 The revised RP 41R-08 is currently not a method RP; it does not provide guidance on a
12 specific practice.

13 Newfoundland and Labrador Hydro (“Hydro”) used an estimate ranging method for the
14 Penstock 3 QRA. The method used is aligned with AACE RP 44R-08, *Risk Analysis and*
15 *Contingency Determination using Expected Value*, which is a current RP that provides
16 guidance for applying the risk-driven expected value method of QRA.

17 As part of the methodology in RP 44R-08, when Monte Carlo Simulation is used a party
18 should

19 ...quantify not only the point cost values (most likely) ... but also the distribution
20 of costs to be entered in the MCS model. The distribution used is typically a 3-
21 point estimate in keeping with the conceptual estimating nature of this practice.
22 There are two probability distributions defined by 3 points (i.e. low, most-likely,
23 and high-cost value). These are the triangular and the pert (or beta pert)
24 distributions...⁴.

25 Hydro used triangular distributions in the MCS model for the Penstock 3 project.

26 To further quote from RP 44R-08,

³ Association for the Advancement of Cost Engineering (2022). Recommended Practice 41R-08 *Understanding Estimating Ranging*.

⁴ Association for the Advancement of Cost Engineering (2021). Recommended Practice 44R-08, *Risk Analysis and Contingency Determination using Expected Value*.

1 “The Monte-Carlo Simulation output is a distribution of possible cost outcomes
2 at different levels of confidence in underrun. Contingency is then the difference
3 between the base estimate cost and the cost at whatever level of confidence of
4 underrun management desires depending on their risk appetite, acceptance or
5 tolerance level. ... Because contingency is by definition “expected to be spent”
6 per RP 10S-90, most companies fund contingency at the mean or P50 value of
7 the distribution. If the overall project was funded at a higher level (e.g. P70), the
8 difference between the P50 (or mean) and P70 is often included as a
9 management reserve. For a major project that has significant impact on the
10 company’s overall capital performance, the p-value is often set at a higher
11 confidence level (e.g. P70 to P80 depending on risk tolerance) because there is
12 no balancing effect of similarly large underrunning projects.”^{5,6}

13 **b)** Values for high and low range estimates were determined by Hydro’s project team. The
14 values were assigned for each item individually and were informed by the bids received for
15 execution of the Penstock 1 Weld Refurbishment and Section Replacement Project
16 (“Penstock 1 Project”), the contract that was in place with the Penstock 1 Project’s
17 Construction Contractor, and knowledge gained through actual execution of the Penstock 1
18 Project.

19 The project team evaluated each of the identified risks and jointly agreed on the ranges of
20 uncertainty for each item, informed by the execution of the Penstock 1 Project, which in
21 some cases resulted in a lower risk profile than that determined for the Penstock 1 Project.
22 As an example, the delivery risk for penstock sections fabricated offsite, which was a
23 significant concern for the Penstock 1 Project, has now been proven to be a lower risk.
24 Conversely, the price risk of raw steel supply is now deemed to be greater than that for the
25 Penstock 1 Project, given the addition of tariffs on steel.

26 These ranges represent the assessed ranges of probable outcomes for each of the estimate
27 items, or the determined uncertainty around each of the estimate items.

⁵ Hydro has been setting P50 as the recommended funding level for contingency. The P50 point is essentially a 50/50 chance of the project costing the value associated with the P50 or less.

⁶ Association for the Advancement of Cost Engineering (2021). Recommended Practice 44R-08, *Risk Analysis and Contingency Determination using Expected Value*.