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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: COMPARISON OF NRC AND AP600 HYDROGEN PRODUCTION MODEL

Dear Mr. Quay:

During the May 20, 1997 meeting between Westinghouse and NRC staff on hydrogen control in the AP600, the staff expressed the need to have additional information on the methodology used for calculation of post-LOCA hydrogen production. Subsequent to the meeting the staff made a request that Westinghouse provide a comparison between the methodology used for AP600 and the methodology included in an appendix to Standard Review Plan Section 6.2.5.

To make the comparison the methodology included in SPR 6.2.5 Appendix A (COGAP) was used in a calculation and the results compared to the results using the AP600 model. The comparison has been completed and is summarized below.

Metal-Water Reaction - The Westinghouse methodology for hydrogen production by the zirc-water reaction is based on a value of 7.9 standard cubic feet (SCF) of hydrogen gas for each pound of zirconium metal reacted. This is within 10% of the COGAP value of 8.5 scf/lb Zr.

Radiolysis - The COGAP methodology for hydrogen production from radiolysis is based on equations that reflect a curve-fit to an early ANS-5.1 draft standard. The Westinghouse methodology is also based on a curve-fit to a summation of beta and gamma energy over a significant number of nuclides (~ 300).

The decay energy values used by Westinghouse are compared to the ANS-5.1 standard in the attached Figure 15.4-1b. Although, the results are noted to be in good agreement, it should be noted that use of the Branch Technical Position recommendation of a 10 percent uncertainty factor between 10^3 and 10^7 seconds, rather than the 20 percent value that was considered, would result in even better agreement. In applying the decay energy model to hydrogen production, the assumptions of Regulatory Guide 1.7 are used in the Westinghouse model. That is, noble gases are assumed to be released to the containment atmosphere, the halogen activity inventory is assumed to be contained in

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the core with the remaining one percent in the sump fluid. The relative fractions are an input to the COGAP code and thus are selected by the user.

The Westinghouse decay energy values are compared to the COGAP equations for "$H_{\gamma+\beta}$ (t), the total solid fission product energy production rate" and "H_I(t), the iodine isotope energy production rate" in Figure 1. The Westinghouse values for Iodine are generally higher than the COGAP values for all decay times; whereas the "other fission products" exceed the COGAP values only in the extremely short and long terms. This probably reflects the fact that the COGAP equations overpredict the standard curve by 20% between 400 and 10^7 seconds and/or that the COGAP formulation overpredicts the radiolytic hydrogen production by a small amount due to a "double-counting" of the gamma energy of those fission products assumed to be released from the fuel rods (see page 6.2.5-13 of SRP Section 6.2.5 - Appendix A).

Also, note that ".. + .3279 exp(-1.1 x 10^5t " should read ".. + .3279 exp(-1.1 x 10^{-5}t " in the definition of H_I (t) on page 6.2.5-13 of the SRP.

Corrosion - The production of aluminum from corrosion is based on the same basic reaction which produces 0.0555 lb-mole of H_2 per lb of aluminum in both the Westinghouse methodology and COGAP. Further comparisons of methodology are not possible since the exponential fit of the Al corrosion rate in COGAP is not given.

Initial Hydrogen Inventory - The Westinghouse methodology considers that the initial RCS and pressurizer inventory of hydrogen is available for instantaneous release after the LOCA. This inventory is not identified as a source that is considered in the COGAP methodology in the DISCUSSION section of the SRP - Appendix A.

This submittal completes the response to the NRC request for information on the hydrogen production methodology. If you have questions or need additional information on hydrogen production please contact D. A. Lindgren at (412) 374-4856.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

jml

Attachment

cc: J. Sebrosky, NRC (w/Attachment)
N. Liparulo, Westinghouse (w/o Attachment)

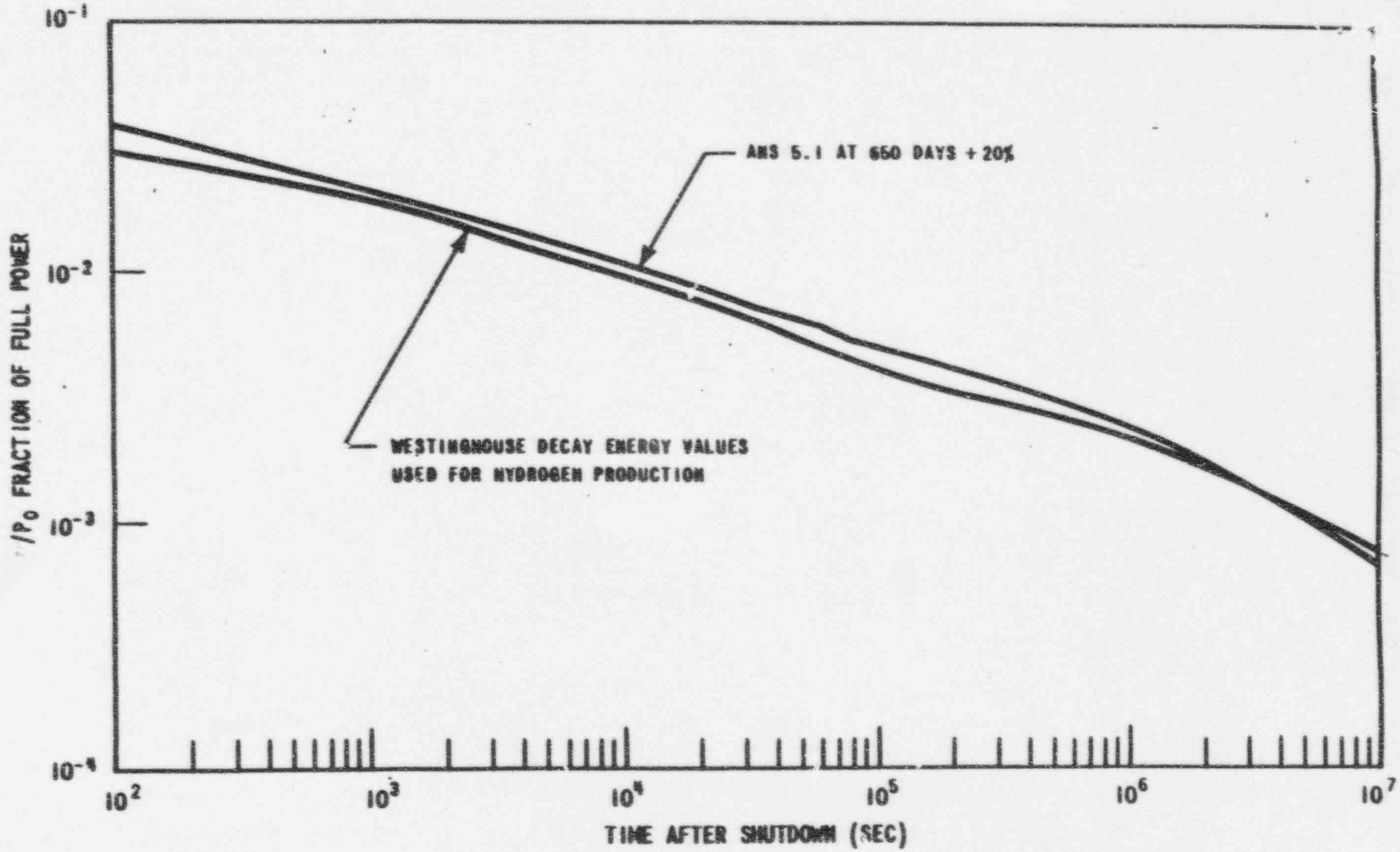

Figure 15.4-1b. Comparison of ANS 5.1 Decay Energy Curve at 650 Days Irradiation + 20% to Decay Energy Values used for H_2 Production Calculation.

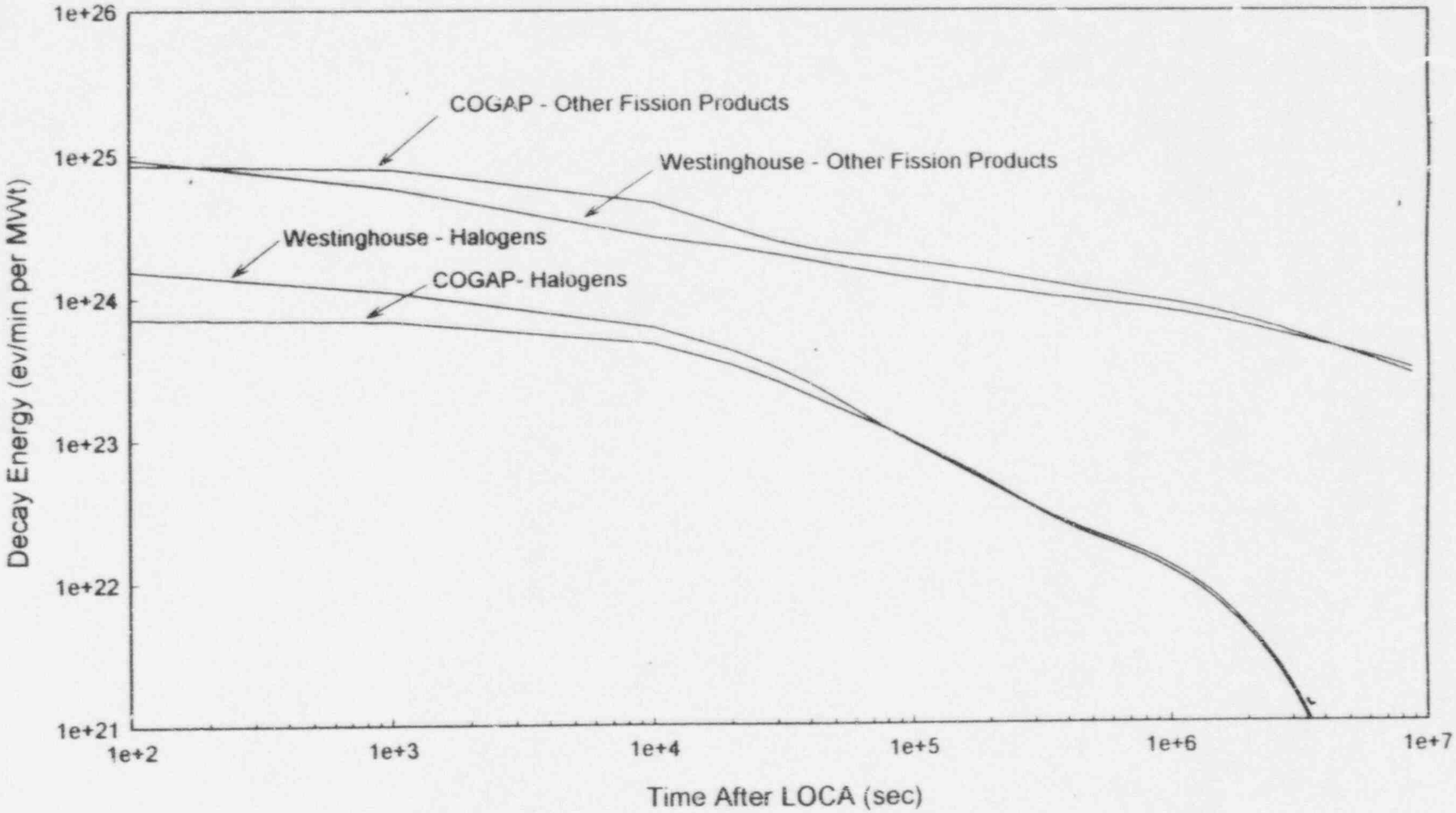

Figure 1 - Comparison of COGAP and Westinghouse
Decay Energies used for Hydrogen Production