IP2 and IP3 SAMA Reanalysis

[1] Introduction

The IP2 and IP3 Severe Accident Mitigation Alternative (SAMA) analyses originally described in the Environmental Report (ER) of the license renewal application, dated April 3, 2007, used site specific meteorological data (wind speed, wind direction, temperature, and accumulated precipitation) obtained from the IPEC onsite meteorological monitoring system (Reference 1). As permitted by NEI 05-01, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document,"[1] (Reference 4) five years of meteorological data (2000-2004) were averaged and used in the original SAMA analyses. Since the SAMA analyses began in the fall of 2005, these five years were the most recent data available at the time of the original analyses. The five-year data included 43,848 (two leap years) consecutive hourly values of wind speed, wind direction, precipitation, and temperature recorded at the IPEC meteorological tower from January 2000 through December 2004. The results of the original SAMA analyses were reported in the ER and clarified in response to questions from the Nuclear Regulatory Commission (References 2 and 3).

As described above, the original SAMA analyses used five year averages of wind speed, wind direction, precipitation, and temperature. The averaging method for wind direction, however, was determined to be incorrect and, as a result, the averaged wind direction data was not representative of wind direction conditions in the region for the five year period (Reference 5). Therefore, the SAMAs have been reanalyzed using a single representative year of meteorological data as described below. As described further in Section [4] below, Year 2000 was selected as the representative year because, of the five years of data, it is the year that resulted in the most conservative (i.e. largest) calculated population doses. Using one representative year avoids the need to average multiple years of meteorological data, including wind direction.

In accordance with NEI 05-01 recommendations, the original SAMA analyses described in the ER included multiple cases including a baseline case with uncertainty and three sensitivity cases (use of a 3 percent discount rate, use of a longer plant life, and consideration of economic losses by tourism and business). The sensitivity cases in the ER did not identify additional potentially cost beneficial SAMAs beyond those already identified by the baseline with uncertainty case.

During their review, the Nuclear Regulatory Commission (NRC) Staff noted that incorporation of tourism and business losses could result in identification of additional cost beneficial SAMAs if it was considered the baseline case and multiplied to account for uncertainties. Therefore, in response to request for additional information (RAI) 4e, Entergy provided the results of a revised uncertainty analysis in which the impact of lost tourism and business was analyzed as the baseline analysis and multiplied to account for uncertainties (Reference 2). This uncertainty case resulted in the identification of two additional potentially cost beneficial SAMAs for IP2 and one additional potentially cost beneficial SAMA for IP3. Since it resulted in the largest number of potentially cost beneficial SAMAs, the RAI 4e analysis case is the most conservative case. The SAMA reanalysis described below was performed for the same most conservative case;

[1] NEI 05-01 was endorsed by NRC in **Federal Register** / Vol. 72, No. 156 / Tuesday, August 14, 2007.

i.e., the RAI 4e analysis case in which the impact of lost tourism and business was analyzed as the baseline analysis and multiplied to account for uncertainties.

Following the SAMA reanalysis, an additional sensitivity case was analyzed to provide a revised response to Round 2 RAI 5 (Reference 3). This sensitivity case determined the impact of applying values derived from NUREG-1570, Risk Assessment of Severe Accident-Induced Steam Generator Tube Rupture, although final industry consensus on the thermally-induced steam generator tube rupture (TI-SGTR) issue has not yet been reached. See Section [8] for a description of this sensitivity case.

As a result of the SAMA reanalysis and sensitivity case using a conservatively representative, single year of meteorological data (2000), three additional SAMA candidates were found to be potentially cost beneficial for mitigating the consequences of a severe accident for IP2 and three additional SAMA candidates were found to be potentially cost beneficial for IP3 (in addition to those previously designated as cost beneficial in Section 4.21.6 of the ER and References 2 and 3).

[2] Preparation of Annual Meteorological Data

The MACCS2 code accepts 8,760 consecutive hourly values (one year) of meteorological data. Each of the five years of meteorological data used in the original analysis was prepared for input into the MACCS2 code by converting values recorded at the primary meteorological tower at the IPEC site to the units used by MACCS2, assigning an atmospheric stability class based upon the temperature data, and using data substitution to fill in limited missing data.

The primary meteorological tower at IPEC records data on an hourly basis at three elevations, 10m, 60m, and 122m. All available data from the 10m elevation of the primary meteorological tower was used in both the original SAMA analysis and reanalysis because it is closest to the assumed release height of 30m and, therefore, would be most representative of the conditions at the point of release. Both the original SAMA analysis and reanalysis assumed a release height of 30m because it is approximately half the height above grade level of the IP2 and IP3 containment buildings, as recommended by NEI 05-01 to provide adequate dispersion of the plume to the surrounding area. Data from this elevation is also currently used in calculations for the effluent release reports submitted to the NRC pursuant to 10 CFR Part 50.36a and the IPEC emergency plan.

Data substitution methods used in the SAMA reanalysis were in accordance with Environmental Protection Agency (EPA) guidance provided in Reference 6. These methods included substitution of limited missing meteorological data with data interpolated, averaged, or curve-fit from previous and subsequent hours and substitution of valid data collected from the 60m elevation. In the MACCS2 input file for 2000, which was conservatively selected for use in the SAMA reanalysis, the following data substitutions were made.

Seventy-four hours of 10-meter wind direction data was missing for day 316 hour 14 through day 319 hour 15 (in METI00.inp). To maintain consistency and wind variability, data from the 60-meter sensor was substituted for the seventy four hours of missing 10-meter wind direction data.

Eight hours of temperature data was missing for day 95 hours 2 through 9 (in METI00.inp). Values for these eight hours were obtained by linear interpolation of the preceding and subsequent valid temperature values.

Data for all meteorological parameters was missing on day 104 hours 10 and 11, day 104 hour 19, day 255 hours 18 and 19, and day 294 hours 10 and 11 (in METI00.inp). Substitute values were obtained by interpolation, curve-fitting, or averaging the preceding and subsequent valid data values as appropriate.

[3] Non-Meteorological Level 3 Model Inputs

In addition to meteorological data, MACCS2 also uses input data for population, land fraction, watershed class, regional economic data, agriculture data, emergency response assumptions, and source terms. These inputs are described in Sections E.1.5 and E.3.5 of the ER.

For the regional average value of non-farm wealth (VALWNF), a value of $208,838.49/person was used in the SAMA reanalysis consistent with sensitivity case 3 in the ER. As mentioned in Section [1], the RAI 4e analysis case (which is ER sensitivity case 3 multiplied to account for uncertainty) is the most conservative case, resulting in the largest number of potentially cost beneficial SAMAs. The reanalysis was performed for the RAI 4e analysis case in which the impact of lost tourism and business was analyzed as the baseline analysis and multiplied to account for uncertainties. Consequently, the revised benefit results for all SAMAs include the impact of lost tourism and business, as described in the response to request for additional information (RAI) 4e (Reference 2).

The other, non-meteorological data were the same as those described for the baseline case in the ER (described in Sections E.1.5 and E.3.5 of the ER). Since the reanalysis uses the same non-meteorological input data as the original RAI 4e analysis case, the only difference between the original RAI 4e analysis and the reanalysis is the meteorological data.

[4] MACCS2 Analysis and Results

As with the original SAMA analysis, the SAMA reanalysis also used MACCS2 to estimate the mean population dose risk (PDR) and offsite economic cost risk (OECR). Preliminary results from MACCS2 using each of the five years of meteorological data (2000-2004) were compared. Since the dose and economic cost results for all of the individual years were similar, the year that resulted in the most conservative (i.e. largest) doses (year 2000) was selected as the representative year for use in the SAMA reanalysis. This method of choosing a representative year agrees with the example provided in NEI 05-01. The revised estimated mean values of PDR and OECR for IP2 and IP3 using year 2000 meteorological data are presented in Table 1 for IP2 and Table 2 for IP3. Comparison of the values in Tables 1 and 2 with those in ER Tables E.1-14 and E.3-14 shows that the individual year PDR and OECR values are larger than the original ER values due to removal of wind direction biases introduced by the faulty wind direction averaging method.

Table 3 provides a breakdown of the total population dose by containment failure mode, similar to information provided in response to RAI 2a (Reference 2).