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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 22 1979

MEMORANDUM FOR: Files, Task Group 3
TMI Special Inquiry Group

FROM: O. D. T. Lynch, Jr.
TMI Special Inquiry Group

SUBJECT: MEETING WITH LAWRENCE LIVERMORE LABORATORY (LLL) OFFICIALS ON ATMOSPHERIC RELEASE ADVISORY CAPABILITY (ARAC) RESPONSE TO TMI ACCIDENT

On Thursday, August 16, 1979, a meeting was held at LLL between members of the LLL division responsible for ARAC and O. D. T. Lynch, Jr., of the TMI Special Inquiry staff, to discuss the capabilities and functions of the ARAC facility during, and in support of, the TMI accident. Those in attendance are listed in Attachment 1.

The ARAC capabi ity and resulting product were discussed in detail. Several reports on ARAC were provided. These reports are indicated in Attachment 2. The times of transmittal and recipients of the ARAC products (relative concentration plot and instantaneous concentrations $\left(\frac{X}{Q}\right)$ were identified. Copies of the LLL ARAC log and Health Physics log were provided. Specific questions regarding the details of ARAC and the program support for the TMI incident were asked. Answers to the questions are briefly indicated below.

1. When did ARAC output (product) become available?

   a. When did system become functional and available for incidents?

   ANS. ARAC became truly functional for incident response in 1976.

   b. When did the system become available for the TMI incident?

   ANS. ARAC was activated at 0820 PST on March 28, 1979, by J. Bufait, DOE. The first ARAC product was provided to J. Bufait, at the Emergency Operations Center (EOC), DOE Headquarters, Germantown, at approximately 1000 hours PST on March 28, 1979. This product was an integrated air and surface concentration calculation using a simple Gaussian model. LLL tried to get a first cut, rapidly, with this simple Gaussian, with a better product expected later when the MATHEW and ADPIC codes, with their necessary meteorological and topographic data, could be cranked into the computer.

   At 1245 PST the product was transmitted to DOE Nevada Operations Office in Las Vegas.

At 1307 PST the product was transmitted to the NRC EOC, Bethesda, Maryland for the first time to Bernie Weiss. There were transmission problems due to facsimile machine incompatability, so the product was finally received at NRC Headquarters approximately 1500 PST.

At 1715 PST on March 30, 1979, the product was transmitted to NRC Region I Office, King of Prussia, for the first time, to Bob Bores. Again, some difficulties were encountered due to machine interfaces.

2. How did ARAC product improve as a function of time and why?

ANS. Chronological listing of improvements:

3/28/79	0800 PST	Simple Gaussian Model (Note: this model was routinely run at LLL as a check on the MATHEW/ADPIC model predictions, but not routinely transmitted to other agencies.)
	1200 PST	MATHEW and ADPIC codes were added without topographic details.
	1700 - 1730 PST	Topographic data added. USGS digitized terrain data. This is to grid size of 62.5 m which was averaged to 2 km grid to match MATHEW and ADPIC grid. For the TMI accident response, ARAC used a 35 m cell height with 14 cells in the vertical.

Meteorological Improvements:

Meteorological data was initially obtained from the National Weather Service circuit from the following local airports:

Muir Air Force Base
Lancaster Airport
Capitol City Airport
Harrisburg Airport
York Airport
Reading Airport

Upper air RAWINSONDES from Pittsburg and Dulles Airports were also utilized as well as standard NOAA fax charts of winds aloft.

3/30/79	0730 PST	Harrisburg Air Pollution Control District was added. This agency also provided historical meteorological data for the area.
	1100 PST	Connected with TMI met tower via telephone from Keith Woodard. Verbal readouts of met data provided hourly from Woodard.

	1800-1900 PST	Prepared to get data directly from met tower. By 3/31/79 obtained tower data routing by automation.
3/31/79	1515 PST	USAF NOAA joint effort, at request of NRC, mobile, upper air station, arrived by C-5A at Harrisburg. Air Force provided mobile RAWINSONDE and NOAA provided PIBAL. Alternated RAWINSONDE and PIBAL every 2 hours. Data telephoned to LLL immediately after each run.

3. What was the resolution of the ARAC product?

   a. Range used for TMI: On the horizontal, 2 km cell size
   On the vertical, 35 m cell size

   b. Area size: An array of 40 x 40 cells on the horizontal and 14 cells in the vertical, based on a Cartesian system, were used. It should be noted that the scale could be varied, if necessary.

   c. Reliability: Within 2 cell widths of the source, MATHEW/ADPIC will underestimate. For the TMI response, LLL used a Gaussian model within this area, which gave good results. For accuracy, the plume is needed to fill the cell. Until this condition is met, the predictions are underestimates.

   d. Vertical: ARAC product could be produced for any stack height, but for TMI provided cuts at three levels: 2 m, 65 m, and 100-250 m above the surface.

   e. Source term: ARAC used a unit source term, (1 Ci/sec.) and an initially gaussian distributed source in the vertical and horizontal.

   f. Product: Basically, two plots: 1. relative concentration (dot plot or smoke plume, no units)

      2. instantaneous concentration, $\frac{X}{Q}$ (sec/m^3)

4. Did resolution of ARAC product change in time?

   ANS. Resolution did not change in time. The same grid size was used throughout the problem.
   Note that there is no simple way to measure any improvement in the product over time. It wouldn t be apparent to the users. However, aircraft measurements agreed very well with the predicted plume dimensions.

5. Who received ARAC products and when:

ANS: See log, provided. The following agencies received ARAC products:

DOE at Harrisburg
NRC at EOC, Bethesda
FAA at Headquarters, D.C.
EG&G, at Las Vegas
DOE at EOC, Germantown
DOE at NV, Las Vegas
NRC at RO-I, King of Prussia

6. What was the frequency of ARAC products?

ANS: ARAC product frequency changed from early times to later in the problem.

DAY 1, 3/28 One run, without and then, with topographic data.

DAY 2, 3/29 Every 2 hours during the day (at Livermore). MATHEW calculations were not performed at night because it was not deemed urgent. However, LLL did have the capability and also a meteorologist and computer technician available 24 hours a day. The decision on ARAC product production was made in Harrisburg, at the DOE Center in consultation with Joe Deal, et. al. (i.e., other participating agencies).

DAY 3, 3/30 Every 2 hours until 1900Z, at which time they went hourly:
1600Z
1800Z
1900Z
2000Z
2100Z
2200Z
2300Z
2400Z

DAY 4, 3/31 Runs as follows:
1400Z
1500Z
1800Z
1900Z
2000Z
2100Z
2200Z
2300Z

7. What was turn-around time from actual real-time met data to product availability, transmission?

ANS: Turn-around times did change, improving from the beginning of the problem. Some difficulty encountered in setting up the FAX receiver units at various agencies. Examples:

For the first run: Using 1600Z met.
Product valid for 1800Z
Transmitted to Harrisburg 1855Z

For a typical later run: Using 2000Z met.
Product valid for 2200Z
Transmitted to Harrisburg 2125Z

ARAC typically able to produce product to Harrisburg after 55-60 minutes from input of met. data. For validity, assumed that the met. was persistent for the interval between input and valid time.

8. Who received briefing and education on ARAC within NRC?

a. When?
b. How Much?
c. What documents on ARAC capability were furnished and when?
d. Can we have copies?

ANS. Roughly, NRC has ARAC knowledge.

1. Earl Markee and others in Hydrology-Meteorology Branch, DSE.

2. Wayne Houston and Jim Martin, Accident Analysis Branch, DSE. NRC has a small contract with LLL on ARAC which is administered by Wayne Houston.

3. George Sauder, formally of LLL, is the new Technical Advisor to a new Commissioner.

4. Doc Collins has had general knowledge of ARAC since 1975-76.

5. Reg Gotchy was deeply interested in ARAC.

6. Bob Kornasiewicz was also knowledgeable of ARAC.

9. Are there any ARAC procedures available to users/customers?

ANS: There are no written procedures developed specifically for users. LLL relies on the various reports out of the ARAC and briefings of 2-3 days at both customer's location and at Livermore.

10. How well do ARAC projections agree with observed data from TMI?

ANS: LLL will have qualitative numbers when they do the President's Commission report. Will have calculations and comparisons with TLD data.

Without a source term, it would be impossible to show how accurate ARAC product was for TMI.

Aircraft observations by EG&G indicated good agreement with ARAC predictions on location and extent of the plume.

11. What information was provided by ARAC product?

ANS: See sample ARAC products:
1. Relative concentrations, no units. Three dimensional projection viewed from above.
2. Instantaneous concentration, $\frac{X}{Q}$, in sec./m^3 at 65 m above surface.

All products shown on a square grid with the UTM coordinates and base and valid time shown in ZULU (GMT) time.

12. What changes were made in information transmitted in time?

ANS: Grids were reoriented in time to account for wind directions to keep the plume and grid on the paper. Other than this, ARAC produced the two plots.

Note: There were two or three 12 hour integrated concentrations developed but LLL doesn't know if they were ever transmitted outside of the ARAC facility.

ARAC also provided NWS summary information to the DOE center, Harrisburg, but to no others.

13. What changes in information would be made as a result of the TMI experience?

ANS: LLL would do more integrated calculations rather than just instantaneous plots. ARAC can provide dose plots and deposition plots, as well as other plots.

Terminals could be located at various places to get ARAC data directly at the facility needing the information.

14. How does ARAC handle variable source terms?

ANS: Variable source terms (up to 5 isotopes) can be directly entered into the program. Operationally, it is practically limited to the meteorological data input timing.

15. Can ARAC provide exposure rate (direct radiation) on the ground?

ANS: ARAC can provide exposure rates on the ground (+ 2 m) using the dose conversion factors found in WASH-1400, plus inhalation doses, etc. But, they need a source term to get the real dose.

O. D. T. Lynch, Jr.
Special Inquiry Group

cc: Group 3
Group 5
Group 6

ATTACHMENT 1

MEETING WITH LLL OFFICIALS ON ARAC RESPONSE TO TMI ACCIDENT

16 AUGUST 1979

LLL, G Division

Marvin H. Dickerson
Paul Gudiksen
Thomas J. Sullivan

NRC, TMI Special Inquiry

Oliver D. T. Lynch, Jr.

ARAC DOCUMENTS PROVIDED TO NRC

TMI-SIG

1. Dickerson, Marvin H., "Atmospheric Release - Advisory Capability (ARAC): Update 1977," IEEE Transactions on Nuclear Science, Vol. NS-25, No. 1, February 1978, pp. 850.

2. Dickerson, Marvin H., and R. C. Orphan, "Atmosphere Release Advisory Capability," Nuclear Safety, Vol. 17, No. 3, May-June 1976, pp. 281-289.

3. Lawver, Bryan S., and Richard C. Orphan, Operations Guide: Atmospheric Release Advisory Capability (ARAC) Site Facility, UCID-17490, Lawrence Livermore Laboratory, July 13, 1977.

4. Lange, Rolf, "APDIC - A Three-Dimensional Particle-in-Cell Model for the Dispersal of Atmospheric Pollutants and its Comparison to Regional Tracer Studies," Journal of Applied Meteorology, Vol. 17, No. 3, March 1978, pp. 320-329.

5. Lange, Rolf and Christine A. Sherman, "Particle-in-Cell vs. Straight Line Gaussian Calculations for an Area of Complex Topography," Joint Conference on Applications on Air Pollution Meteorology, American Meteorological Society, Boston, Nov. 29-Dec. 2, 1977, pp. 225-231.

6. Lange, Rolf, PATRIC, A Three Dimensional Particle-in-Cell Sequential Puff Code for Modeling the Transport and Diffusion of Atmospheric Pollutants, UCID-17701, Lawrence Livermore Laboratory, January 1978.

7. Sherman, Christine Sygitowicz, MATHEW: A Mass Constant Wind Field Model, UCRL-52479, Ph.D. Thesis, Lawrence Livermore Laboratory, May 1978.