April 10, 2011

MEMORANDUM TO: Brian W. Sheron, Director
Office of Nuclear Regulatory Research

FROM: James T. Wiggins, Director ***/RA Michele Evans for/***
Office of Nuclear Security and Incident Response

SUBJECT: USER NEED MEMORANDUM – REQUEST TO PERFORM UPGRADES TO THE MELCOR ACCIDENT CONSEQUENCE CODE SYSTEM2/WINMACCS CODES IN SUPPORT OF RISK INFORMING EMERGENCY PREPAREDNESS

Background

Project: Risk Informing Emergency Preparedness (EP) – Identification of Credible Accident Scenarios

The SRM COMDEK-08-0005, "FY2010 Nuclear Regulatory Commission (NRC) Performance Budget Proposal" dated September 11, 2008, provided, in part, direction to the Office of Nuclear Security and Incident Response (NSIR) staff to begin the next major EP enhancement of quantifying the level of protection that should result from actions taken in support of EP plans and to codify them in regulations that are transparent. NSIR Division of Preparedness and Response (DPR) initiated a project with Sandia National Laboratories to identify a suite of accident scenarios that could be used to quantify the benefit of EP and provide a regulatory basis for EP oversight. That work is proceeding well. It builds upon previous work done in consequence analysis through detailed modeling of emergency response in the MELCOR Accident Consequence Code System (MACCS2) code.

However, our experience has identified areas for improvement in the MACCS2 code and to its graphical user interface, Windows MACCS (WinMACCS). We understand that there is a continuing project to modernize MACCS2 and we have funds available to support specific enhancements in Fiscal Year 2011. The purpose of this work is to enhance EP modeling and make the code easier to use. This would improve the accuracy of NRC consequence analyses and enhance the ability to perform site specific analyses at any nuclear power reactor site.

CONTACT: Randy Sullivan, DPR/IRIB
(301) 415-1123

Description of Work

Recent consequence analysis projects have utilized enhancement in the MACCS2 code to better model emergency response. However, these efforts involve manual entry of evacuation time and cohort information for each cohort at the ring level. There are typically 17 rings and at least 6 cohorts. For multiple analyses and sites, this can require manual input of more than a thousand entries each time the response timing parameters are modified. The code also lacks the ability to use road loading curves requiring the analyst to manually apply step changes to represent population movements. Evacuation time estimates (ETE) have become very sophisticated in modeling population movements, and most have detailed road loading information that could be used if MACCS2 were configured to accept such data.

MACCS2 uses multiple weather trials to probabilistically estimate risk to populations geographically. Emergency response plans utilize localized evacuation to protect populations at risk, i.e., downwind from the plant. Consequence analyses must assume 10-mile 360-degree evacuation due to the use of multiple (200-600) weather trials. This is a reasonable approximation given the tools available. However, results would be more accurate if MACCS2 could combine protective action response with weather trials. This would also more accurately model the dynamic of wind shifts and subsequent changes to protective actions.

Areas of Needed Assistance

1. Modify MACCS2 to accept population movement data representing a road loading curve and perhaps other characteristic data available in a standard ETE:

    - Review typical ETE (NSIR will make available standard examples) and determine characteristics of data files and compatibility with MACCS2.
    - Discuss potential modeling changes to determine the benefit and scope of changes needed. Determine which modeling enhancements can reasonably be achieved.
    - Develop specific work requirement, schedule, and resource needs.
    - Perform work, test, document, and issue revised codes.

2. Modify MACCS2 to integrate likely initial protective actions and response timing with weather trials to model expansion of protective actions due to radiological conditions and wind shifts:

    - Review typical protective action cases. NSIR will provide a briefing with the necessary information.
    - Outline coding infrastructure necessary to select protective action appropriate to each weather trial.
    - Discuss potential modeling changes to determine benefit and scope of changes needed. Determine which modeling enhancements can reasonably be achieved.
    - Develop specific work requirement, schedule, and resource needs.
    - Perform work, test, document and issue revised code.

3. Improve Quality Assurance for EP parameters by improving the WinMACCS user interface and input functions to reduce the potential for input error and increase the speed of input application:

    - Allow input of English units for speeds and distances. Use of international system of units values for speeds and distances currently require manual conversion. Display tables and outputs using English units, e.g., hours/minutes, miles per hour, miles.
    - When directions and speeds are input into Emergency Scenario 1, the graphic display should show the values on subsequent Emergency Scenarios such that when any group is opened, the visual display represents the WinMACCS values to be used. Currently, the default values remain on these screens although the change cards actually reflect the Emergency Scenario 1 values.
    - Develop an automated method for changing or modifying response timing parameters. There are typically 17 rings and at least 6 cohorts. For multiple analyses and sites, this can require manual input of more than a thousand entries each time the response timing parameters are modified.
    - Allow use of a Shift or Control key to select sectors on the map for inputting speed variables rather than using the sector table on the right side of the screen to change multiple sectors.
    - When adding a speed multiplier on the map, allow inserting of a lower value (i.e., factor of 0.5) without the need to change all default values of 1. This will require WinMACCS to regenerate the map with the new values.
    - Create an ability to enlarge graphics to fit the screen and to print mapping for review and presentation.
    - Consider combining the data entry screen for parameters DURBEG and DURMID and the data entry screen for ESPEED and ESPMUL. Combining these screens reduces the risk of entry errors by the analyst.
    - Provide additional output options to streamline post-execution evaluation of results, perhaps with a separate output file or post-processing application.

Document work in a draft project report suitable for publication. The report should be reviewed by the NRC and comments provided to the contractor for revision. The final draft should be revised in accordance with NRC review.

Schedule and Milestones

To be determined.

Coordination

We request the Office of Nuclear Regulatory Research (RES) complete the efforts described above to support NSIR staff effort to explore the feasibility of enhancing MACCS2 in support of efforts to risk inform EP oversight. The Inspection and Regulatory Improvements Branch in NSIR has coordinated this user's need request with the Performance and Reliability Branch in RES. Members of both branches have discussed and agreed upon the scope of the tasks in this request. NSIR staff is prepared to work with RES staff to complete the schedule for these activities.

Funding

Title: MACCS2 MODELS DEVELOPMENT AND UTILITY CODES IMPROVEMENTS

NSIR will initially transfer $60,000 to RES to fund the tasks described above. An additional $60,000 will be transferred as funds become available. It is understood that the schedule may be impacted should funding be limited or delayed.

From: NSIR**:**
B&R: 2011-11-11-7-122
JCN: R3149, R3151
Amt: $60,000

To: RES**:**
B&R: 2011-60-11-6-110
JCN: V6227
Amt: $60,000

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