Preprint
UCRL-JC-137966

The ARAC-RODOS-WSPEEDI Information Exchange Project

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This article was submitted to
European Union/Commission of European Committee Radiological
Operational Decision Support System
Rhodes, Greece
September 20-24, 1999

September 1, 1999

U.S. Department of Energy
Lawrence
Livermore
National
Laboratory

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Under the auspices of a US DOE-JAPAN Memorandum of Understanding JAERI and LLNL agreed to develop and evaluate a prototype information exchange protocol for nuclear accident emergency situations. This project received some interest from the US DOS and FEMA as it fits nicely under the umbrella of the G-7's GEMINI (Global Emergency Management Information Network Initiative) project. Because of LLNL/ARAC and JAERI/WSPEEDI interest in nuclear accident consequence assessment and hazard prediction on all scales, to include global, we were happy to participate.

Subsequent to the Spring 1997 RODOS-ARAC Workshop a Memorandum of Agreement was developed to enhance mutual collaboration on matters of emergency systems development. In the summer of 1998 the project leaders of RODOS, WSPEEDI and ARAC met at FZK and agreed to join in a triangular collaboration on the development and demonstration of an emergency information exchange protocol. JAERI and FZK are engaged in developing a formal cooperation agreement. The purpose of this project is to evaluate the prototype information protocol application for technical feasibility and mutual benefit through simulated (real) event;

quick exchange of atmospheric modeling products and environmental data during emergencies,

distribution of predicted results to other countries having no prediction capabilities, and

utilization of the link for collaborative studies

During 1997 JAERI and LLNL acquired SGI high-end engineering workstations and the InPerson tele-video conferencing software package. After working through the various setup options a series of successful tests were conducted. One Internet communications path was explored and satisfactorily developed to demonstrate proof-of-principle. In fact, a real accident occurred in Japan during March 1997 (PNC explosion/fire) which provided an opportunity to exploit and stress the prototype protocol under development. The outcome proved very positive, though limited in live video. In June of 1998 ARAC developed assessments of the Algeciras, Spain cesium source accident and posted the results on the ARAC protocol test website.

The technology side of the Internet emergency information system can be broken into two components—hardware and software. Furthermore, the hardware of the system can be considered as two major components—the computer platform on which the system runs, and the network over which information is exchanged. Currently, a Silicon Graphics Indy workstation serves as the platform at both ends of the connection. The Indy has a 133 MHz processor in it, and is capable of processing the current data thoughput. A 19" color monitor is essential for displaying numerous concurrent windows containing often complex color graphics. After some early tests, we found it necessary to upgrade the memory from 96 Mb to 160 Mb to accommodate the numerous large visual buffers generated by the Web browser and video-teleconference application during a typical session. Also, the Indy was soon running out of disk space (due to lack of swap space), so a second local disk was also added to the workstation. With these improvements, the Indy functioned well during real-time sessions, even with the Web browser running and several active whiteboards. An ISDN connection was

Worked performed under the auspices of the U.S Department of Energy by the Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48

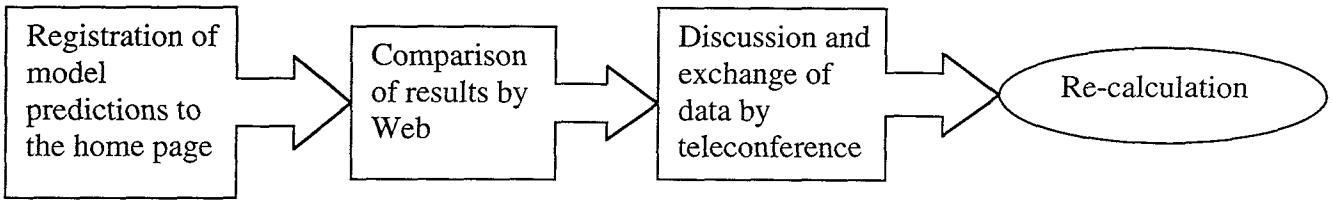
also added in preparation for possible future applications. This will be discussed in the next section. Other required hardware includes a microphone and a video camera for capturing these portions of the session for transmission to the other conference participants.

At the outset of the project, several network options were considered for the video-teleconference portion of the session. The first option was the standard Ethernet connection to the Internet, also used by the Web browser. There was concern about the unreliability of the bandwidth, especially during windows of peak Internet usage. This problem in fact did show up early in the testing, and it became necessary to disable the video portion of the video-teleconference tool as standard practice in order to allow transmission of the audio and whiteboard data. To date, this is the only network option actually tested with real data, mainly because of budgetary constraints. Other options considered were: 1) a dedicated point-to-point leased line, which is currently unrealistic because of cost; 2) ISDN, which has begun to be tested locally, though a US-Japan connection has not yet been tried. This has the potential of providing guaranteed 128Kb throughput, and could possibly accommodate the video signal on one channel (64Kb), while the audio and whiteboard are transmitted on the other.

The software for the project can also be considered as two components, the Web site/browser portion and the video-teleconferencing tool. For the Web site itself, where the actual computational data and graphics are posted and exchanged, a number of password-protected pages were written in CGI and HTML. The already existing WWW pages of ARAC and JAERI have proven to perfectly fit with the requirements of the information exchange. Each Web site permits privileged users to log on and review the computational results for a given facility. Accessible information includes model parameters and assumptions used in the calculations, graphical displays of wind data, and plots of predicted concentrations, dose and deposition. These plots and data can be easily extracted and annotated for use in scheduled teleconferences. Netscape is the current Web browser for the project, and has proven satisfactory for accessing, viewing and saving information from the remote Web sites. It is also typically used during a conference, as reference is constantly being made to information on the Web which may not be included in the white boards. During the Hungarian INEX exercise (Paks, 3 November 1998) a first triangle test was conducted using the WWW pages of WSPEEDI and ARAC. The result as stated by FZK was: "the communication with JAERI and LLNL worked perfectly and—given the different working times—the results were obtained very quickly and comprehensively."

The final component of the system to be considered is the video-teleconference tool. As in the case of the network itself, several options were considered at the outset of the project. The SUN product, ShowMe, was briefly considered, but was soon abandoned when the decision was made to go with Silicon Graphics workstations. When the SGI decision was made, the clear choice was InPerson, a video-teleconference tool which comes bundled with the SGI workstation. Like most video-teleconferencing tools, InPerson consists of three components—a video handler, an audio handler, and a whiteboard application. Each component is highly configurable and is easy to use. Both the video and audio components allow variable sampling rates for each signal to reduce the bandwidth required by each. As mentioned above, it became necessary to freeze the video signal completely because of its tendency to degrade the other signals when in use. The default ISDN-like bandwidth of 128Kb setting was used, with total bandwidth set of 100Kb. This allowed a clear audio signal to be transmitted, though a delay of 5–10 seconds was experienced. This delay was not due to bandwidth per se, however, but to unavoidable Internet congestion problems at the various bridges and gateways between the US and Japan. A trace of the route revealed individual node delays of up to 5 seconds during peak Internet usage. Similar whiteboard delays were also experienced, but the overall performance of the system was acceptable. The gain of interactive data exchange, including real-time display and annotation of figures as well as concurrent verbal discussion were invaluable.

During the Tokai accident and shortly thereafter ARAC and JAERI were able to view each system's model assessment plots, discuss differences, locate measurements sites and values, discuss differences due to differences/deficiencies in meteorological data and then recompare and discuss results when comparable data were used in both systems. The dialogue with whiteboard interaction proved highly effective in communicating mutual understanding as well as unique insights. The shortfall of full live video was evident but not detrimental. The results accomplished over a two-week period in a cooperative response to an actual event would have been impossible to achieve using conventional exchanges via phone, e-mail and telefax. The combination of the Web pages by the teleconferences yielded a collaborative effort which could only have been otherwise achieved by actual face-to-face meetings. In fact, this prototype system provides an advantage over the face-to-face exchange, as each participant is acting from their own institutional environments, where all local data and even colleagues are readily accessible, whereas travelers must reduce their tools and information to fit in a suitcase.



Since ARAC and SPEEDI provided similar results for the PNC fire/accident by using the same input data, we judged it could be used for estimation of source term coupling with monitoring.

As a result of our experiences and discussions we are extending the RODOS-developed World Wide Web data exchange format using Keywords-values in ASCII files for simplicity, ease-of-use, and easy "self proofing." It became evident during both the Algeciras accident and the INEX exercise that a simple, yet reliable, data exchange format was necessary for the expeditious exchange of information.

For the near future we are planning on finalizing the data exchange formats and then conducting three-way data exchange tests. We are also closely watching the Pentium-class tele-video conference software package market evolution and we will soon select a candidate to test and evaluate in our triangular configuration. Our long term goal is to expedite and demonstrate a multi-point tele-video conferencing capability that could serve as a reliable information exchange medium for transboundary type accident response and mutual support.