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SUMMARY/MINUTES
ACRS HUMAN FACTORS SUBCOMMITTEE
APRIL 19, 1989
Bethesda, Maryland

The ACRS Human Factors Subcommittee met at 8:30 a.m., April 19, 1989, 7920 Norfolk Avenue, Bethesda, Maryland. Dr. Forrest Remick was the Chairman for this meeting. The other ACRS members in attendance were: Mr. James Carroll, and Mr. David Ward. Herman Alderman was the cognizant ACRS staff member for this meeting.

Dr. Remick noted the purpose of the meeting was to review the agency's human factors programs and initiatives. He introduced the other ACRS members in attendance and asked if there were any comments. Mr. Carroll noted that he thought the document submitted for the meeting was an improvement over the document discussed during the last sub- committee meeting. He said he was pleased that activities of other offices had been included. He asked if the program plan would be issued as a NUREG.

Dr. Remick introduced Byron Sheron who made the opening presentation.

Mr. Byron Sheron, Research

Mr. Sheron presented the background of the human factors programs within the Commission. He noted that in May of last year, the first draft of the Human Factors Research Program Plan was prepared. That

was sent to the Commission in SECY-88-141. The Commission responded with a SRM asking the staff to address seven specific items in the SRM. The staff replied to the Commission in SECY-88-294, telling the Commission of their plans to update the research plan. This update plan was presented to the human factors subcommittee in January 1989.

In February 1989, Mr. Stello informed research that the program plan shall involve all the human factor activities throughout the agency.

Mr. Sheron noted that the final document would be issued as a NUREG.

Mr. Carroll asked if anyone ever thought of undertaking human factors type of research on how to select and train senior resident inspectors and evaluate their performance.

Mr. Sheron replied he would bring it to the attention of NRR. He said any need for that would have to come from NRR.

Ms. Clare Goodman, Human Factors Assessment Branch, presented an overview of human factors activities in NRR. She noted one of the efforts involves root cause analysis. She said they hoped to investigate the root causes of personnel errors and come out with more detailed human performance information.

She noted that a large area deals with Emergency Operating Procedures. The primary focus was on procedure generation packages. These provided a basis for writing EOPs. Problems were encountered with undocumented deviation from the generic guidelines. The emphasis has shifted to the EOPs. The EOP's November program noted weaknesses. The problems have come from not documenting the technical bases of the EOPs.

Dr. Remick asked to what extent are the licensees using the "good" learning tools from training and incorporating them in such things as EOPs, so that an operator might have a graphics to help him visualize what he is doing.

Ms. Goodman replied that a lot of EOPs are using flow charts developed in training.

Ms. Goodman noted that one of the initiatives is in the area of advanced computer oriented systems. Evaluation of advanced systems in the control room is something that has to be done.

Regarding the control room design review, Ms. Goodman noted that this process is still going on. This has been a very lengthy process. One of the problems has been in hiring qualified consultants. Another problem has been priorities.

Ms. Goodman discussed the Safety Parameter Display System. Many utilities do not fully meet the requirements. A generic letter was issued with guidance as to what is acceptable.

Ms. Goodman discussed training and qualifications. In 1985 a policy statement was issued on training and qualifications which endorsed the INPO managed training accreditation. Two years later the policy statement was updated. In 1988 an advanced policy statement was issued. The latest policy statement continues to endorse INPO accreditation.

Dr. Remick asked if there was any research to try to evaluate the effectiveness of training.

Ms. Goodman replied that research is working on a project to develop criteria and methods to measure training effectiveness.

Ms. Goodman noted the policy statement on professionalism. The policy statement states that the Commission believes that it is essential that utility or licensing management at every facility establish and maintain a professional working environment that focuses on safety.

She discussed operator examinations and licensing. There are three initiatives. The qualification program has been rewritten and revised to be more operationally oriented and more performance based.

The second initiative involves the fundamentals examination. This is a generic examination that covers fundamental theory concepts, i.e. thermodynamics. All operators may take this examination on a voluntary basis. If they pass this, then the equivalent part of the plant specific examination is waived.

The third initiative is the national examination schedule. There are specific dates assigned to each facility instead of assigning dates on a case-by-case basis. This allows the facilities and the NRC to plan training programs and resources around specific dates.

Ms. Goodman mentioned organization and management. She noted that NRR has supported other offices in this area and has conducted special inspections. Research is working on developing methods and standardized protocol that could be used by people in going out and conducting these inspections.

She discussed programs that incorporate human performance information.

The maintenance inspection effort looks at management support of maintenance, communications among maintenance operations, personnel and training of maintenance people.

The SALP and Senior Management meetings involve human performance information.

The Senior Management meetings are scheduled for every six months. The Senior Management meeting attempts to focus on problem plants. Human factors performance considerations might include Emergency Operating Procedures and the status of the Safety Parameter Display System. The results of these meetings are presented to the EDO, office directors, and NRC Senior Management.

Dr. El-Bassioni, Risk Applications Branch, NRR, discussed PRA Applications. He noted that they are sponsoring a program with Brookhaven National Laboratory. This program focuses on the variation in human error. He said the PRA integrates design and operations so they have the benefit of human errors with the design features of the plant. He said they have the feeling that human error is a major contributor to risk and they want to confirm their feeling that human contribution to risk is quite significant.

Dr. El-Bassioni noted the work started in 1980 and was based upon the Surry plant model in WASH 1400. The model presented the state of the art in 1975. Most of the model errors were pre-accident or pre-initiated errors like misalignments and maintenance related things. The study renoted the conclusion that human error is quite significant in terms of its risk impact. He noted that some other conclusions were really a reflection of the model itself. He said the model reflected the state of the art with pre-accident errors as the dominant types of errors as far as risk is concerned. He noted the model had about 800 human errors.

Dr. Remick asked if there was any attempt to determine what was the chance of the error being made, was there a probability associated with that error?

Dr. El-Bassioni replied that a nominal value of 10 to the minus 3 was assigned to the error. The study changed the error probability by a factor of two, a factor of five and a factor of ten. The error was then improved by a factor of three, ten and twenty.

This produces a curve that is rising from one side and saturated on the improvement side. This is mainly because what was modeled was mainly hardware dominated and the human error was minimal.

Dr. El-Bassioni discussed the latest study. This study models the Oconee plant. The current study shows that you can achieve improvements. The nominal value for human error is about 10 to the minus 4. He noted that this is a more sophisticated study. He stated that they have divided human errors into categories of errors. This information is used to direct inspection efforts, or to see where it counts in terms of risk.

Mr. Gene Trager, AEOD, discussed the AEOD programs involving human factors. These programs include routine operational event assessment, the performance indicator program, the incident investigation program, the diagnostic evaluation program, the nonreactor assessment program, and the technical training center activities.

He noted that AEOD addresses performance problems during the analysis and evaluation of operating data.

He noted that AEOD conducts case studies, engineering evaluations, and patterns assessments, and technical reviews based upon operating events described in LERs and other sources. Findings and conclusions of the reports influence programs intended to improve human performance.

Mr. Troger mentioned three studies that dealt with human performance problems. AEOD/5401 of the types of events that were the result of inadequate labeling of various equipment and components, in adequate personnel training and experience, and inadequate procedures.

AEOD C504 was a report on the loss of safety system function events. This report found that improvements had been made in the areas of management and administrative control procedures, and training would have a significant impact on reducing the number of these events, and that licensed operators and non-licensed operators and other personnel such as technicians and maintenance personnel were responsible for roughly equal number of errors.

The third study was significant events involving procedures. It was found that procedures were a contributing factor in about 85 percent of the events that involved human performance.

He said that AEOD is responsible for developing and evaluating licensee performance indicators and producing the quarterly report.

Working with AEOD, RES conducts conceptual and other longer term studies and makes recommendations regarding the suitability of alternative indicators.

He noted the work on event cause data. In the past, RES began work to determine whether event cause data could be used in the performance indicator and AEOD subsequently performed further analysis of operational data to perform this indicator. AEOD then recommended and received approval by the Commission to use LER causes as an additional indicator.

He discussed the Incident Investigation program. The Incident Investigation program is designed to determine the nature and causes of significant events and to reduce the frequency and consequences of these events. Consistent with the IIT objectives, all incident investigation teams will include an expert in the field of human factors. All potential IIT members are expected to be certified through formal training in incident investigation. Human factors guidance has been developed by NRR and is part of the peripheral IIT training program.

He discussed the diagnostic evaluation program. The diagnostic evaluation program evaluates the level of human performance and the courses of performance problems. Test evaluations include plant operations, maintenance, testing, engineering support, organization and management. Management consultants are used to assist the diagnostic evaluation team in assessing management and organizational

climate factors and their relationship to the overall safety performance of the plant.

Mr. Trager spoke of the non-reactor efforts. He noted that at the present time AEOD is studying multiple medical misadministrations involving the use of computers and has identified several areas that involve human factors.

Another study is underway on the use of iodine procedures that may also identify human factors improvements.

He pointed out that AEOD can provide searches of event files to accumulate data with frequency and characteristic of non-reactor events.

He noted human factors research at the technical training center. As an example, he cited in the team skills and behavior research, the technical training center staff simulated operating crews at a typical facility and ran scenarios in the NRS SNUPPS simulator. The crew actions were observed and recorded to validate the methodology.

Mr. Trager concluded with a listing of future AEOD activities. These include a review of foreign events in the incident reporting system file and human factors events, analyzing events where cognizant errors led to a series of inappropriate actions, survey NRC requirements to evaluate the impact on operators, summarize human factors concerns raised in previous AEOD studies, and develop capabilities to investigate human factors concerns from operating events.

Mr. Frank Coffman discussed the human factors regulatory research program. He noted that the basic purpose of the research program is to provide the technological basis for the regulations. It is characterized primarily by a multidisciplinary effort heavily relying upon the behavioral sciences, and involving a variety of engineering disciplines. He noted that it was mainly regulatory support but there is some research which is based on foundation research to anticipate human performance safety issues.

He stated that the research needs originate out of regulatory situations where either the technical basis is not, or the nature of the potential safety problem is not well defined.

Dr. Remick asked what criteria is used within the agency to determine whether NRR is going to have something done under technical assistance or whether they request research to handle some things?

Dr. Jones replied that it was basically the length of time involved. Long term items generally go to research.

Mr. Coffman mentioned some of the user needs that have been identified and are being worked on include, needs for more credible data on human errors and particularly in determining the causes or root causes. Investigation protocols are also included.

He noted the tech spec. improvement effort. This effort in NRR is directed toward first eliminating from the tech specs. the

requirements that are not really critical to safety. The next step is to be able to flag adverse combinations of equipment out for tech spec maintenance as surveillance.

Mr. Coffman discussed activities other than response to regulatory user needs. He noted four Chernobyl followup items. He mentioned work with AEOD on the design of the new operations center. They are providing some direct support on management inspections and human-system interface reviews. They are working with AEOD in specifying the upgrades of the simulators at the Technical Training center.

Dennis Serig discussed human factors activities at NMSS. He said they would like to be able to address all types of material and fuel cycle activities because human error is reported in many of the events throughout the office's scope of activities. He noted that specific areas of high priority are medical use and industrial radiography.

Under medical use he noted the growing accumulation of reports on misadministrations. These concerns misadministration of by product materials.

He noted that radiographers receive a large percentage of occupational exposures and this is largely due to human error.

Mr. Serig noted the study on circadian rhythms is very important for issues related to nuclear pharmacies where people work late at night preparing materials that are dispersed during the daytime, and in hospitals, and also in industrial radiography situation where part

of the event work is done in the middle of the night and no other people are supposed to be on the site.

Mr. Serig discussed brachytherapy. This is inserting sealed sources into the body through the use of a remote afterloading device. A computer controlled machine inserts the device after the physician has left. This reduces occupational exposure.

Mr. Serig said the Commission paper on high level waste management is a high priority item. He noted that presently he is involved in gathering information.

Dr. Jay Persensky discussed human factors research. He noted that the personnel performance measurement is to establish a structure for data gathering. He said this concerns how does the agency improve its data gathering to be able to get to the root-cause analysis.

Personnel performance measurement has several topic areas:

One is the development of a standardized protocol to investigate events that involve human error. This would be for both materials licensees and nuclear power plants.

Another part is to take the data and put it into a data management structure so that it can be worked with, and analyze it and access it for different types of activities such as regulatory activities or further research activities.

Dr. Persensky discussed the inspection module. This would be provided to the regions or to the special inspection teams and it would give them an idea as to how to go about collecting human performance data.

He noted that they believed they could get new data from LERs from the utilities by providing better guidance to them as to what they should report and how they should report it.

Dr. Persensky mentioned the personnel subsystem element. This involve staffing, qualifications and training. He noted the research elements are to broaden the understanding of what happens to people and what people can do.

This also includes development of regulatory guidance related to these issues. He noted that the Commission has endorsed the INPO accreditation program on training.

Regarding severe accident issues, he noted that many of the current training simulators cannot handle severe accidents. This is going to require a change in simulators. He noted that they are working with the severe accident people on the human factors issues.

He stated that there have been many changes to the licensed operator examination process and the staff feels there should be an evaluation of how well the changes have worked.

Dr. Persensky mentioned the policy statement on working hours. This policy statement discusses shift scheduling and shift rotation. He noted that the policy statement still hasn't left NRR. He noted the need for confirmatory research in working hours. He said the policy statement provided guidance for those utilities that use 12 hour shifts.

Dr. Persensky discussed the human system interface. This is the person-machine interface and includes hardware, procedures and documentation. The staff is looking at advanced control rooms and looking at replacing analog systems with digital systems in the current control rooms. The staff is also looking at different types of job performance aids such as expert systems and procedures.

Dr. Persensky pointed out some of the issues under human engineering. He noted they are in the process of doing a value impact as to whether or not there should be further regulation in the local control station area. This would be for shutdown panels and anything else outside the control room and would concern how they are laid out from a human factors standpoint. The staff is doing a value impact on improvements to annunciator systems. The staff is looking at human computer interaction.

He noted the projection verification and validation. This project is being done with EPRI. It is to look at development of guidelines for the verification and validation of software for expert systems.

Dr. Persensky discussed procedures. He noted that there is guidance for emergency operating procedures but no guidance for any other procedures.

Mr. Carroll noted the existence of ANSI-N-18-7, Reg. Guide 1.33 which has a section on writing procedures.

Dr. Persensky stated that those procedures are not function oriented. The type of guidance is not as nearly detailed.

He noted that they are looking at procedure violations as a follow-up to Chernobyl. They are looking at possible problems with violations of procedures.

Dr. Ryan discussed the organization and management, and reliability assessment elements of the program. He noted that the organization and management element proceeds from the recognition that the operation of a nuclear power plant both during normal and abnormal conditions, is for the most part a team or group process. Any serious analysis of underlying causal factors of human performance certainly needs to take into consideration organization management.

The reliability assessment element recognizes the fact that human error is a significant contributor to plant reliability risk.

He noted the organization and management element is a top-down perspective. He said they are interested in three topic areas:

One having to do with techniques for characterizing the entity of interest, the power plant, the utility or whatever.

Following that is needed some kind of instrumentation for gathering status information on organization in management.

Finally, this information has to be indexed for either performance indicator work or risk assessment or whatever the application happens to be.

He noted the work on organizations is being done in three phases. The current work is studying the organization during normal operations, abnormal operations and the transition that occurs between the two states. Work will start shortly in the plant-utility relationship. Eventually the staff may consider outside entities such as public utility commissions and the NRC and the impacts of these entities on the plant.

Dr. Ryan noted the work on performance indicators. The staff is working on performance indicators to determine how well a plant is operating.

He noted they have some cognitive modeling work going on with the Westinghouse Research and Development Center in which they are starting to look at issues like tunnel vision and serial decision making. This is making the first decision in a series. There is a human tendency to block out any information that might counter the decision that we have committed ourself to.

Dr. Ryan discussed indicators. He noted they are developing indicators in the maintenance area. He mentioned work in the area of training program indicators. He noted work on management indicators during normal operations. He said they expect to get into some of the management indicators for off-normal conditions by 1991.

He noted they are looking at Chernobyl spin off items. The first one has to do with taking a look at the current state of NRC regulations on plant management. The second item has to do with lessons learned from Chernobyl and the applications of the accident data.

Dr. Ryan discussed the reliability assessment element. He noted they are attempting to develop data methods and to consider combinations of the human and hardware combinations. He said the human performance data and hardware performance data will proceed in parallel.

Dr. Ryan noted the work organization management. This work involves the development of an algorithm for taking the information on organization management and integrating it into peer probability calculations.

The meeting was adjourned at 3:20 p.m. *****

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NOTE: A transcript of the meeting is available at the NRC Public Document Room, Gelman Bldg. 2120 "L" Street, NW., Washington, D.C. Telephone (202) 634-3383 or can be purchased from Heritage Reporting Corporation, 1220 L Street, NW., Washington, D.C. 20005, Telephone (202) 628-4888.