

October 11, 2002

MEMORANDUM TO: ACRS Members

FROM: August W. Cronenberg, Cognizant ACRS Staff Engineer  
Med El-Zeftawy, Designated Federal Official

SUBJECT: CERTIFICATION OF THE MINUTES OF THE ACRS  
SUBCOMMITTEE HUMAN FACTORS  
September 10, 2002 - ROCKVILLE, MARYLAND

The minutes of the subject meeting, issued September 23, 2002, have been certified as the official record of the proceedings of that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc: J. Larkins  
S. Bahadur  
H. Larson  
S. Duraiswamy  
ACRS Staff Engineers



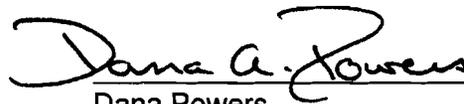
UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, D.C. 20555-0001

MEMORANDUM TO: August W. Cronenberg, Cognizant ACRS Staff Engineer  
Med El-Zeftawy, Designated Federal Official

FROM: Dr. Dana Powers, Subcommittee Chairman

SUBJECT: CERTIFICATION OF THE SUMMARY/MINUTES OF THE MEETING  
OF THE ACRS SUBCOMMITTEE ON HUMAN PERFORMANCE,  
SEPTEMBER 10, 2002 - ROCKVILLE, MARYLAND

I do hereby certify that, to the best of my knowledge and belief, the minutes of the subject meeting on September 10, 2002, are an accurate record of the proceedings for that meeting.

  
Dana Powers,  
Subcommittee Chairman

  
Date

PRE-DECISIONAL

September 23, 2002

MEMORANDUM TO: Dr. Dana Powers, Subcommittee Chairman  
Human Factors

FROM: August W. Cronenberg, Cognizant ACRS Staff Engineer  
Med El-Zeftawy, Designated Federal Official

SUBJECT: WORKING COPY OF THE MINUTES OF THE ACRS  
SUBCOMMITTEE ON HUMAN FACTORS,  
SEPTEMBER 10, 2002 - ROCKVILLE, MARYLAND

A working copy of the minutes for the subject meeting is attached for your review. Please review and comment on them at your soonest convenience. If you are satisfied with these minutes please sign, date, and return by FAX (301-415-5589) the attached certification letter.

Attachment: Minutes (DRAFT)

cc: S. Bahadur  
S. Duraiswamy  
J. Larkins  
H. Larson

CERTIFIED BY:  
D. Powers - 10/11/02

Date:09/23/02

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
SUBCOMMITTEE ON HUMAN FACTORS  
MEETING MINUTES - September 10, 2002  
ROCKVILLE, MARYLAND

**INTRODUCTION**

The ACRS Subcommittee on Human Factors met on September 10, 2002, at 11545 Rockville Pike, Rockville, MD, in Room TWFN/2-B3. The purpose of this meeting was to discuss progress related to the agency's research programs on Human Reliability Analysis (HRA) and Human Factors (HF). The purpose and scope of these activities was discussed, as well as the relationship between the two disciplines. Presentations included examples of how human factors (HF) data and information are incorporated into agency human reliability analysis (HRA) tools, and how HRA can be used to identify and prioritize research needs.

The Subcommittees received no written comments from members of the public regarding the meeting. The entire meeting was open to public attendance. Mr. August W. Cronenberg was the cognizant ACRS staff engineer for this meeting. Mr. Med El-Zeftawy was the designated federal official. The meeting was convened at 8:30 am and adjourned at 3:20 pm

**ATTENDEES**

ACRS

D. Powers	Subcommittee Chairman	G. Apostolakis	Subcommittee Member
M. Bonaca	Subcommittee Member	G. Leitch	Subcommittee Member
S. Rosen	Subcommittee Member	P. Ford	ACRS Member
J. Sieber	ACRS Member	T. Kress	ACRS Member
G. Wallis	ACRS Member		

Principal NRC Speakers

Nathan Siu	RES
Erasmia Lois	RES
Julius Persensky	RES

Principal Industry Speakers: Mr. Bruce Hallbert, Idaho National Engineering Laboratory)

A complete list of attendees is in the ACRS Office File and will be made available upon request. The presentation slides and handouts used during the meeting are attached to the office copy of these minutes.

## **OPENING REMARKS BY THE SUBCOMMITTEE CHAIRMAN**

Dr. Powers opened the session by noting that the ACRS is on record with respect to its views on human factors (HF) issues, that is that 'human factors is the emerging reactor safety issue of the future'. He noted that the agency recognizes that HF is a 'cross-cutting issue' that impacts all cornerstones of reactor safety. DR. Powers then went on to note that, at times, the ACRS has been quite critical of agency research activities in the human factors (HF) area. He stated that the NRC needs to maintain expertise in the various areas of human factors, and that conducting relevant research is a means to maintain such expertise. He then summarized the primary objectives of the meeting, which concern questions regarding:

- what research should be done to maintain agency expertise in human factors, and
- what additional research should be initiated to improve the effectiveness of NRC's activities now and in the future?

Dr. Powers noted that when he discussed the organization of the subcommittee with Dr. Siu and Mr. Jit Singh beforehand, he requested that the staff bring the subcommittee up to speed on recent HF accomplishments and the planning of future HF research programs. He noted that several items have been puzzling to the ACRS with respect to human factors research, including:

- relatively little definitive analysis of the risk effects of power uprates that reduce times available for human actions under uprate conditions,
- chaotic results of human error analysis for steam generator tube rupture events, and
- relatively little progress in what the ROP (reactor oversight program) call cross-cutting issues of human performance, and
- challenges faced by inspection staff in following recommendations from the ROP.

He noted that the proposed agenda was such that it should provide clarification of these items. He closed his remarks by noting that he anticipated a letter on the subject, and that at the end of the day he would poll members on the outline and contents of such a letter. He then called upon Dr. Siu to begin the staff presentations.

## **DISCUSSION OF AGENDA ITEMS**

### **NRC Staff Presentation**

Dr. Nathan Siu (RES) opened the staff presentations by introducing parties at the speakers table, namely Mr. Scott Newberry (RES), Mr. Julius Persensky (RES), and Ms. Erasmia Lois (RES). He then outlined the overall agenda for the meeting and indicated that his introduction would be followed by presentations of others seated at the presenter table, beginning with Mr. Scott Newberry, the program director for human factors research.

Mr. Newberry opened the staff remarks with a 6-slide presentation that provided an overview of briefing objectives and current Human Factors (HF)/Human Reliability Analysis (HRA) research. Mr. Newberry stated that the primary objectives were to provide the ACRS with an overview of HRA/HF research efforts and obtain feedback from the ACRS on future activities in these areas. His remarks mostly centered on his 5th slide, which provided an overview of HRA/HF

performance goals regarding a) reactor safety, b) agency efficiency/effectiveness, c) reduction of unnecessary burden to the industry, and d) improvement of public confidence. He discussed how these goals are linked to agency rules/regulations and licensing/monitoring activities. Dr. Powers noted that a good example was agency research on HF related to fire protection issues. Mr. Newberry ended his presentation with a slide introducing the next speakers and the topics they would cover; namely Ms. Erasmia Lois on HRA research efforts and Mr. Julius on HF research. Mr. Newberry then noted that he had other commitments and would not be able to stay. He asked if there were any additional comments or questions; hearing none he introduced the next speaker, Erasmia Lois, and excused himself from the meeting.

Ms. Lois provided a 9-slide presentation the Human Reliability Analysis (HRA) research program. Slide-3 provided a graphical representation on how human factors (HF) and human reliability analysis (HRA) research support each other. ACRS member Graham Leitch noted that most plants were built with analog instrumentation and are converting to digital systems. He asked if HF and HRA aspects of this conversion have been considered in agency HF/HRA research. Mr. Julius Persensky answered that some limited agency work has been done in this area, but more work has been done by EPRI (Electric Power Research Institute). Dr. Powers commented on slide-3, noting that the essential element of translating HF information into HRA models are the numerical values ascribed to some human performance element, and 'how good is good enough' regarding these numerical values. He also commented that licensee SARs (Safety Analysis Reports) for power uprates indicate little impact of the uprate on the timing of operator response to off-normal conditions, in spite of the higher decay heat at uprated conditions. He encouraged the staff to better quantify the impact of a higher decay heat/reduced operator time for uprated conditions. He noted that ACRS has expressed concerns in this area in recent uprate reviews. Dr. Ford asked if ergonomic features related to control-room instrumentation layout were factored into HRA tools. Mr. Persensky replied that yes, HRA analysts try to consider such effects in HRA models. Dr. Ford also questioned if HRA models of operator response time consider such factors as operator age or experience. Dr. Siu replied that, in general, such "micro-algorithms" are not currently modeled in HRA codes.

Ms. Lois then when on to slides 4 and 5, with considerable discussion on slide-5 which presented an overview of HRA modeling activities and how they fit into agency rules, licensing activities, and the ROP (reactor oversight program). Prof. Apostolakis interjected that it is curious that the NRC inspectors at Davis -Besse did note the number of changes of clogged filters at the plant but failed to act, and does this not point to a HF weakness in the agency's ROP. Ms. Lois responded that they are now more involved in guidance development for the inspection and plant oversight programs. ACRS member Rosen interjected that he didn't see any indication on slide-5 of how the total of human factor performance at a plant translates to something akin to "Overall Safety Culture" for that plant. Dr. Powers interjected that if RES went to the Commission for funding on "Safety Culture" research, it would be summarily rejected. Prof. Apostolakis stated that "safety culture" however is indeed an important element in any HF program. He advised to call it something else, e.g. 'latent errors' or some other indicator of 'integrated HF plant performance'.

Presenter Lois then went on with the remainder of her presentation, which centered on HRA efforts for advanced reactors and data collection/analysis efforts. Members Graham Wallis and Apostolakis noted that although they supported HRA work on advanced reactors, they felt there

were more pressing agency HRA and HF issues, specifically with regards to power uprates. They noted uprate uncertainties related on reduced times for accident mitigation via human performance due to higher uprate coolant enthalpy/decay heat, particularly when equipment like ECCS is not upgraded for the higher power level. Mr. John Flack, from the NRC staff, responded that RES has a program on 'synergistic effects', where such issues are being investigated.

Ms. Lois then ended her presentation with a final slide (slide-9) listing current HRA activities, which brought the meeting to 10:20am, at which point Dr. Powers called for a 20 minute recess, until 10:40am.

*Break: 10:20-10:40 am*

Dr. Powers reconvened the morning session at 10:40 am and introduced the next speaker, Mr. Julius Persensky of RES, who summarized the agency's HF research program in a five slide presentation. The presentation gave a broad overview of current human factor research activities and needs for additional research. Member Wallis asked if the NRR user needs request to RES come with a detailed definition of what information is needed and how it is to be used by the agency. Mr. Persensky responded that yes, such requests are indeed quite specific. Member Rosen asked if there is any agency work on HF for plant crews as a unit, versus HF information for differences in crew composition. Mr. Persensky answered that RES data is not so specific so as to look at person-specific crews, and that no such data exists to his knowledge.

Member Apostolakis stated that he had read the Davis-Besse root cause analysis report and noted that there was no corrective action for re-occurring identified problems. He asked if the agency has any program to track nil response to such maintenance reported problems. Mr. Persensky responded that this is really the responsibility of the agency's corrective action program and not something HF is specifically tracking, although there is indeed a human factors element to the problem. Mr. Persensky ended his presentation by noting that a significant part of the HF program involves data gathering and pointed to the Halden simulator project, located in Halden Norway, to be discussed next. Member Powers posed one final question, asking if the agency would be better served if it had it own dedicated simulator rather depending on the Halden simulator, which is a mockup of the Finish Loviisa reactor. Mr. Persensky responded that the Halden simulator can be configured to model both U.S. PWR and BWR plants. Mr. Persensky then introduced the last speaker of the morning, Mr. Bruce Hallbert of the INEEL (Idaho National Engineering and Environmental Laboratory).

Mr. Hallbert began his presentation at about 11:30 am. He stated that most of his 17-slide presentation relates to HF data gathering efforts at the Halden simulator, largely stemming from his work in the mid-90's, while he was located at the Halden project. He began his presentation with several introductory slides on how simulator data can provide useful HF data for use in HRA analysis tools such as ATHENA. He noted that current HRA tools do not make full use of simulator data. He also noted (see slide-5) that most of the data he would speak to resulted from an NRC sponsored/funded project at Halden, related to an assessment of variability of control room staffing levels for advanced reactors. He noted that the data was generally a measure of the time for appropriate response (i.e. time to complete prescribed emergency response procedures....ERPs) to various plant off-normal conditions versus crew size (normal

crew= 4, reduced crew= 2 or 3). The data involved time response measurements of 8 different crews presented with 5 different scenarios, 4 crews at full staffing levels (4 member crew) and 4 reduced size crews (2 or 3 members per crew). Member Rosen asked if the 8 crews were always comprised of the same people, to which Mr. Hallbert responded that yes each crew always was comprised of the same members. Member Rosen then noted that this was somewhat atypical of actual control room staffing situations, since crews generally have rotational characteristics due to vacation, sick leave, and other crew absentee factors. Mr. Hallbert agreed, but stated that this effect was not within the scope of the project.

Member Bonaca inquired how the conclusion was reached that the Halden simulator, which is a mockup of the Finish Loviisa reactor, adequately represents US plants; specifically with regards to operator training and emergency response procedures (ERPs). Mr. Hallbert responded that they traveled to the Loviisa plant and found that the training level and procedures were quite similar to that for US plants. He also noted that the Loviisa reactor has one of the highest safety ratings and minimal downtime history for off-normal events. Member Kress asked what the y-axis represented in slide-9, specifically 'simulator awareness with a scale form 0 to 1.0'. Mr. Hallbert responded that it represents a standardized index based on operator response to a questionnaire on various factors, including awareness of plant and instrument conditions for a specific event. Mr. Hallbert then presented some closing slides on information relating how the Halden data was gleaned for PSF data (Performance Shaping Factor), to which member Apostolakis noted that such PSF data was much needed for HRA codes and complimented Mr. Hallbert on his efforts.

Dr. Powers closed the morning session by thanking Mr. Hallbert for his informative presentation. He went on to note that the afternoon session would center on his solicitation of member views on the following items:

- RES plans regarding HRA codes,
- How "safety culture" effects could be factored into future HF/HRA research efforts,
- What the state of the art is regarding adequacy of HRA computational tools,
- What other HF data sources/experiments would be valuable in addition to simulator data.

He then closed the morning session at about 12:55 am and stated that the afternoon portion would commence at 2pm.

*Lunch Break: 12:55 am - 2:00 pm*

Dr. Powers opened the afternoon session at about 2:05 pm and stated that his primary interest for the remainder of the meeting centered on understanding the HF/HRA near-term research plan, which he noted would be the subject of a full-committee letter.

ACRS staff engineer Cronenberg asked if there has ever been an NRR user need request to RES, asking for RES input on human factor questions for recent power uprates of the 15-20% range. He noted that recent licensee uprate applications generally indicate nil impact of the uprate on operator performance and response time, as well as overall risk. He said this was contrary to findings of the 'Khatib-Rahbar' study, indicating reduced time for operator response due to higher decay heat levels at uprated conditions and a resultant increase in several risk

matrixes. Dr. Siu indicated that RES has not received any NRR user-need requests to review such issues for recent power uprate applications. Mr. John Flack, NRC staff in the audience, interjected that although there hasn't been any specific request from NRR in this regard, RES does have a program underway regarding "synergistic effects" and that such issues are being investigated as part of that effort.

Member Rosen noted that much of the discussion today was devoted to control-room human performance, and asked if the staff was developing tools and collecting data on human performance for inspection/maintenance activities or organizational performance. Mr. Hallbert responded that HF people realize that there are many ways in which human errors occur during maintenance activities and there is some limited data on the subject. He noted however that there is not much in the way of 'tools' or 'code development' in this area. Dr. Siu interjected that some limited code work has been done on maintenance errors, but what is not being covered is data collection on multiple maintenance errors, such as occurred at Davis-Besse. Member Apostolakis interjected that a good indicator of such 'multiple maintenance errors' would be to assess the number of 'deferred fixes', where some group decision is made to defer some repair.

Dr. Powers then asked the staff if a 'home-grown simulator' would be desirable, cost considerations aside. Mr. Persensky responded that in the best of all possible worlds, yes such a dedicated facility would be quite helpful for human performance data collection. Dr. Powers then asked the staff to summarize the high-priority items of HF/HRA research plan, to which Dr. Siu responded that data integration into a common HRA model was high on the list, as well as development of human factors inspection and maintenance guidance.

Dr. Powers then stated that the formal/transcribed portion of the meeting would come to a close, but that he would like to ACRS members and interested staff to return to the subcommittee room at about 3:40pm, so that he could conduct a 'round-table poll' of ACRS concerns/comments. On a final note, Dr. Powers stated that this HF/HRA subcommittee was the 'best' in his recollection. He then closed the meeting by thanking the staff for a "well-done" presentation.

*Meeting Closed at 3:20 PM*

## **SUMMARY of SUBCOMMITTEE COMMENTS, CONCERNS, AND RECOMMENDATIONS**

Subcommittee members raised the following significant points during its discussion with the NRC staff representatives.

- Dr. Powers opened the session by noting that the ACRS is on record that 'human factors is the emerging reactor safety issue of the future', and that the agency recognizes that it is a cross-cutting issue that impacts all cornerstones of reactor safety.
- Dr. Powers noted that several items have been puzzling to the ACRS with respect to past human factors research, including (a) relatively little definitive analysis of the risk effects of power uprates that reduce times available for human actions under uprate conditions,

- (b) chaotic results of human error analysis for steam generator tube rupture events,
- (c) relatively little progress on cross-cutting issues of human performance, and
- (d) challenges faced by inspection staff in following recommendations from the ROP.

- ACRS member Graham Leitch noted that most plants were built with analog instrumentation and have, or are now converting to, digital systems. He asked if HF/HRA aspects of this conversion have been considered in agency HF/HRA.
- Dr. Powers commented that recent licensee SARs (Safety Analysis Reports) for power uprates indicate little impact of the uprate on the timing of operator response to off-normal conditions, in spite of the higher decay heat at uprated conditions. He noted that the ACRS has encouraged the staff to better quantify the impact of a higher decay heat and reduced operator time for uprated conditions. He noted that ACRS has expressed concerns in this area.
- Prof. Apostolakis commented that it is curious that the NRC inspectors at the Davis-Besse plant were aware of a number of changes of clogged filters at the plant, yet appropriate root-cause analysis was not done. He noted that this is indicative of HF weaknesses in the agency's reactor oversight program. He followed up by noting that the Davis-Besse event clearly points to "safety culture" issues, and that such issues are indeed an important element in any HF research program.
- Dr. Powers interjected that if RES went to the Commission for funding on 'safety culture research', such a request would be summarily rejected. Prof. Apostolakis stated that 'safety culture' however is indeed an important element in any HF research program. He advised the staff to call it something else, e.g. 'latent errors' or some other indicator of integrated HF experience.
- ACRS members Dr. Apostolakis and Rosen made the point that they didn't see any indication of how the total of human factor performance for a plant translates to something akin to 'safety culture'. They noted that the ACRS is well aware that such 'plant safety culture' is indeed a central factor in overall plant safety. They reemphasized that in light of the Davis-Besse experience, there is indeed a need for NRC research on 'integrated plant human performance', in other words 'plant safety culture'.
- Member Apostolakis stated again that he had read the Davis-Besse root cause analysis report, and noted in several places that there was no corrective action for re-occurring identified problems. He asked if the agency has any program to track nil response to such maintenance reported problems. The staff responded that this is really a responsibility of the agency's corrective action program and not something HF is specifically tracking, although there is indeed a human factors element to the problem.
- Members Graham Wallis and Apostolakis noted that although they supported HRA work on advanced reactors, they felt there were more pressing agency HRA/HF issues; specifically with regards to power uprates. They noted uncertainties on reduced times for accident/event mitigation via human performance efforts due to higher coolant enthalpy

and decay heat conditions, and said this would be a particular concern for mitigation equipment like ECCS, which are not being upgraded.

- Dr. Bonaca inquired how the conclusion was reached that the Halden simulator, which is a mockup of the Finish Loviisa reactor, adequately represents US plants; specifically with regards to operator training and emergency response procedures (ERPs).
- Member Rosen asked if there was any agency work on HF for plant crews as a unit, versus HF information for individuals, or differences in crew composition. He went on to state that the staff had presented considerable HF-simulator performance data at the individual level, but no data at the team or crew level, or how various teams perform and interact with each other at the integrated plant level. He said the latter was a glaring hole in the HF/HRA research program.
- Dr. Powers asked the staff if a 'home grown simulator' would be desirable, cost considerations aside. The staff responded that in the best of all possible worlds, yes such a dedicated facility would be quite helpful for human performance data collection.
- On a final note, Dr. Powers stated that this subcommittee was the best in his recollection on HF and HRA. He then closed the meeting by thanking the staff for a 'well-done' presentation.

- **SUBCOMMITTEE DECISIONS AND ACTIONS**

The subcommittee briefing of September 10, 2002 was summarized at the follow-up 495<sup>th</sup> ACRS full-committee meeting, on Thursday September 12, 2002. The outcome of the subcommittee and full-committee briefings was an ACRS letter to Dr. William Travers, Executive Director of Operations, with the following primary ACRS observations and recommendations:

- The Human Reliability Analysis Program needs to articulate its long-term vision of the technology necessary to the agency. This vision should include the availability of a well-validated model for quantifying individual and team error rates.
- The past focus on overt, individual errors of omission is being augmented to include latent human errors and needs to be expanded to address explicitly team interactions both in the control room and elsewhere in the plant.
- Human Factors and Human Reliability Analysis research programs should be expanded to search for leading indicators of degradation in human performance, both at the individual and group levels.
- The NRC should consider development of a control room simulator devoted to support research on human factors and human reliability.

**BACKGROUND MATERIALS PROVIDED TO THE SUBCOMMITTEE PRIOR TO THIS MEETING**

1. Subcommittee Status Report
2. **NUREG/IA-0137**, *A Study of Control Room Staffing Levels for Advanced Reactors*, (Nov., 2000).
3. **NUREG/CR-6691**(BNL-NUREG-52600), *The Effects of Alarm Display, Processing, and Availability on Crew Performance*, (Nov. 2000)
4. **SECY-01-0196**, *Status of the NRC Program on Human Performance in Nuclear Power Plant Safety*, (Nov. 1, 2001).
5. **OECD/NEA/CSN Paper**, N. Siu, E. Thornsby, and M. Cunningham, *The NRC Human Reliability Analysis (HRA) Research Program*, paper given at OECD/NEA/CSNI Workshop on HRA, (May, 2001).

\*\*\*\*\*

**Note:** Additional details of this meeting can be obtained from a transcript of this meeting available for downloading or viewing on the Internet at "<http://www.nrc.gov/ACRSACNW>" or can be purchased from Neal R. Gross and Co., Inc., (Court Reporters and Transcribers) 1323 Rhode Island Avenue, NW., Washington, DC 20005 (202) 234-4433.

For the Nuclear Regulatory Commission.  
**Cheryl Trotter,**  
*Chief, Environmental and Performance  
 Assessment Branch, Division of Waste  
 Management, Office of Nuclear Material  
 Safety and Safeguards.*  
 [FR Doc. 02-21416 Filed 8-21-02; 8:45 am]  
 BILLING CODE 7590-01-P

## NUCLEAR REGULATORY COMMISSION

### Advisory Committee on Nuclear Waste Meeting on Planning and Procedures; Notice of Meeting

The ACNW will hold a Planning and Procedures meeting on September 23, 2002, Bob Ruud Community Center, 150 N. Highway 160, Pahrump, Nevada.

The entire meeting will be open to public attendance, with the exception of a portion that may be closed pursuant to 5 U.S.C. 552b(c) (2) and (6) to discuss organizational and personnel matters that relate solely to internal personnel rules and practices of ACNW, and information the release of which would constitute a clearly unwarranted invasion of personal privacy.

The agenda for the subject meeting shall be as follows: *Monday, September 23, 2002—3 p.m. until 4:45 p.m.*

The Committee will discuss proposed ACNW activities and related matters. The purpose of this meeting is to gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Oral statements may be presented by members of the public with the concurrence of the Chairman; written statements will be accepted and made available to the Committee. Electronic recordings will be permitted only during those portions of the meeting that are open to the public, and questions may be asked only by members of the Committee, its consultants, and staff. Persons desiring to make oral statements should notify the Designated Federal Official named below five days prior to the meeting, if possible, so that appropriate arrangements can be made.

Further information regarding topics to be discussed, the scheduling of sessions open to the public, whether the meeting has been canceled or rescheduled, the Chairman's ruling on requests for the opportunity to present oral statements, and the time allotted therefor can be obtained by contacting the Designated Federal Official, Howard J. Larson (telephone: 301/415-6805) between 7:30 a.m. and 4:15 p.m. (EDT). Persons planning to attend this meeting

are urged to contact the above named individual two working days prior to the meeting to be advised of any changes in schedule that may have occurred.

Dated: August 15, 2002.  
**Howard J. Larson,**  
*Acting Associate Director for Technical  
 Support, ACRS/ACNW.*  
 [FR Doc. 02-21419 Filed 8-21-02; 8:45 am]  
 BILLING CODE 7590-01-P

## NUCLEAR REGULATORY COMMISSION

### \*Advisory Committee on Reactor Safeguards Meeting of the ACRS Subcommittee on Human Factors; Notice of Meeting

The ACRS Subcommittee on Human Factors will hold a meeting on September 10, 2002, in Room T-2B3, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance.

The agenda for the subject meeting shall be as follows: *Tuesday, September 10, 2002—8:30 a.m. until the conclusion of business.*

The Subcommittee will review the proposed Human Reliability Research Program Plan, including research activities and plans related to data collection and development of analysis tools on human reliability associated with nuclear power plant operation and safety. The purpose of this meeting is to gather information, analyze relevant issues and facts, and to formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Oral statements may be presented by members of the public with the concurrence of the Subcommittee Chairman; written statements will be accepted and made available to the Committee. Electronic recordings will be permitted only during those portions of the meeting that are open to the public, and questions may be asked only by members of the Subcommittee, its consultants, and staff. Persons desiring to make oral statements should notify one of the ACRS staff engineers named below five days prior to the meeting, if possible, so that appropriate arrangements can be made.

During the initial portion of the meeting, the Subcommittee, along with any of its consultants who may be present, may exchange preliminary views regarding matters to be considered during the balance of the meeting.

The Subcommittee will then hear presentations by and hold discussions with representatives of the NRC staff and other interested persons regarding this review.

Further information regarding topics to be discussed, whether the meeting has been canceled or rescheduled, and the Chairman's ruling on requests for the opportunity to present oral statements and the time allotted therefor can be obtained by contacting either Dr. Medhat M. El-Zeftawy (telephone 301-415-6889) or Mr. August W. Cronenberg (telephone 301-415-6809) between 7:30 a.m. and 4:15 p.m. (EDT). Persons planning to attend this meeting are urged to contact the above named individuals at least two working days prior to the meeting to be advised of any potential changes to the agenda, etc., that may have occurred.

Dated: August 15, 2002.  
**Howard J. Larson,**  
*Acting Associate Director for Technical  
 Support, ACRS/ACNW.*  
 [FR Doc. 02-21420 Filed 8-21-02; 8:45 am]  
 BILLING CODE 7590-01-P

## NUCLEAR REGULATORY COMMISSION

### Advisory Committee on Reactor Safeguards Subcommittee Meeting on Planning and Procedures; Notice of Meeting

The ACRS Subcommittee on Planning and Procedures will hold a meeting on September 9, 2002, Room T-2B1, 11545 Rockville Pike, Rockville, Maryland.

The entire meeting will be open to public attendance, with the exception of a portion that may be closed pursuant to 5 U.S.C. 552b(c) (2) and (6) to discuss organizational and personnel matters that relate solely to internal personnel rules and practices of ACRS, and information the release of which would constitute a clearly unwarranted invasion of personal privacy.

The agenda for the subject meeting shall be as follows: *Monday, September 9, 2002—10:45 a.m. until 12:30 p.m.*

The Subcommittee will discuss proposed ACRS activities and related matters. The purpose of this meeting is to gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Oral statements may be presented by members of the public with the concurrence of the Subcommittee Chairman; written statements will be accepted and made available to the Committee. Electronic recordings will







*United States  
Nuclear Regulatory Commission*

---

# NRC Human Reliability Analysis and Human Factors Research Programs: *Overview*

Scott Newberry and Farouk Eltawila

Office of Nuclear Regulatory Research

Presented to  
Subcommittee on Human Factors  
Advisory Committee on Reactor Safeguards  
USNRC Headquarters • Rockville, MD • 10<sup>th</sup> September 2002

# Briefing Objectives

---

- **Provide overview of NRC's human reliability analysis (HRA) and human factors (HF) research programs**
  - **Activities**
  - **Relationship and interactions**
- **Obtain feedback to inform ongoing planning activities**

# Briefing Outline

---

- **Why HRA and HF research and development?**
- **Discipline and program relationships**
- **HRA needs and activities**
- **HF needs and activities**
- **Joint research: a data-collection example**

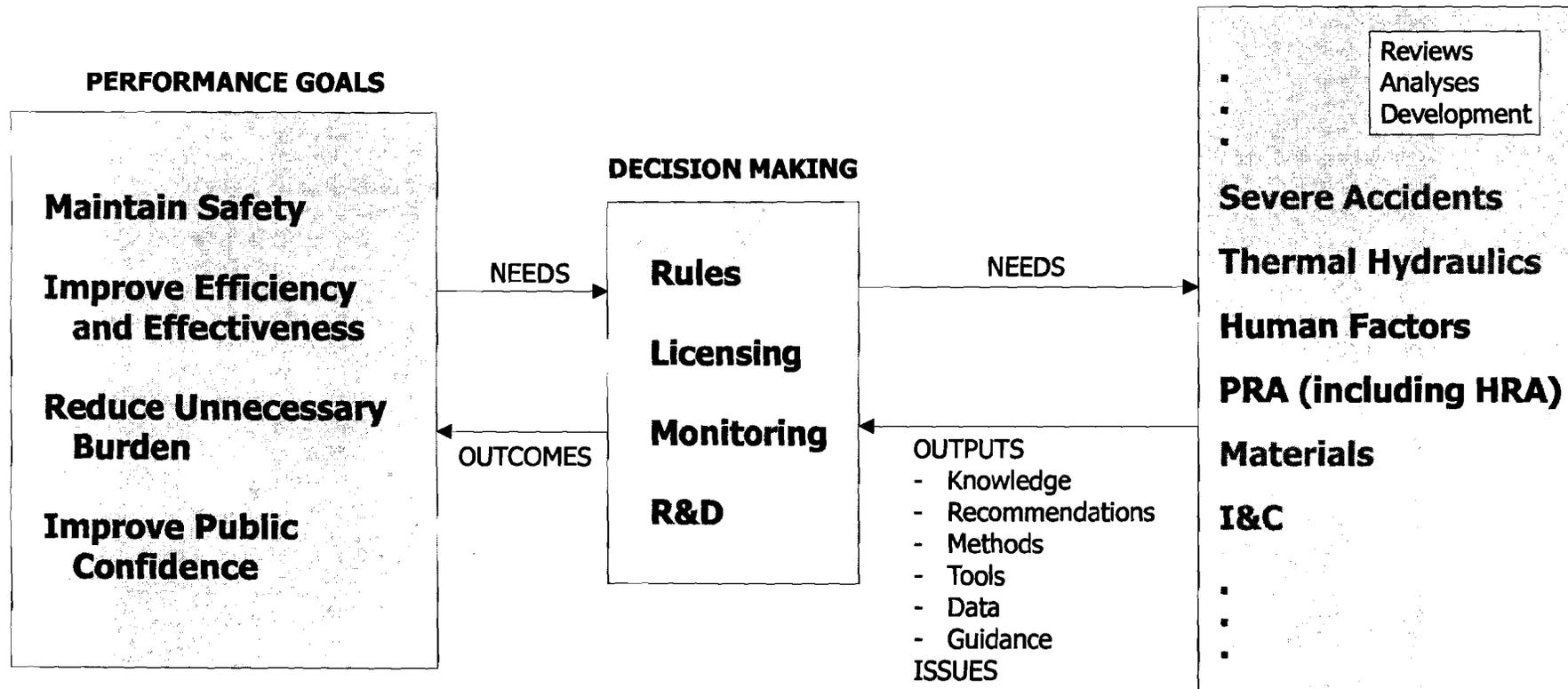
# Why HRA and HF R&D?

---

- **Agency needs**
- **Operating event experience**
- **PRA experience**
- **Trends and future events**
- **Typical questions**
- **Activity types**

# Supporting Agency Needs

## RESEARCH AND DEVELOPMENT



# Programs

---

	<b>Human Factors</b>	<b>HRA</b>
<b>Organization</b>	<b>RES/DSARE</b>	<b>RES/DRAA</b>
<b>Technical Lead</b>	<b>J. Persensky</b>	<b>E. Lois</b>
<b>Plan</b>	<b>SECY-01-0196 (Nov. 2001)</b>	<b>HRA Research Program Plan (May 2001)</b>



*United States  
Nuclear Regulatory Commission*

# NRC Human Reliability Analysis Research Program

Erasmia Lois

Probabilistic Risk Analysis Branch

Office of Nuclear Regulatory Research

Presented to

Subcommittee on Human Factors

Advisory Committee on Reactor Safeguards

USNRC Headquarters • Rockville, MD • 10<sup>th</sup> September 2002

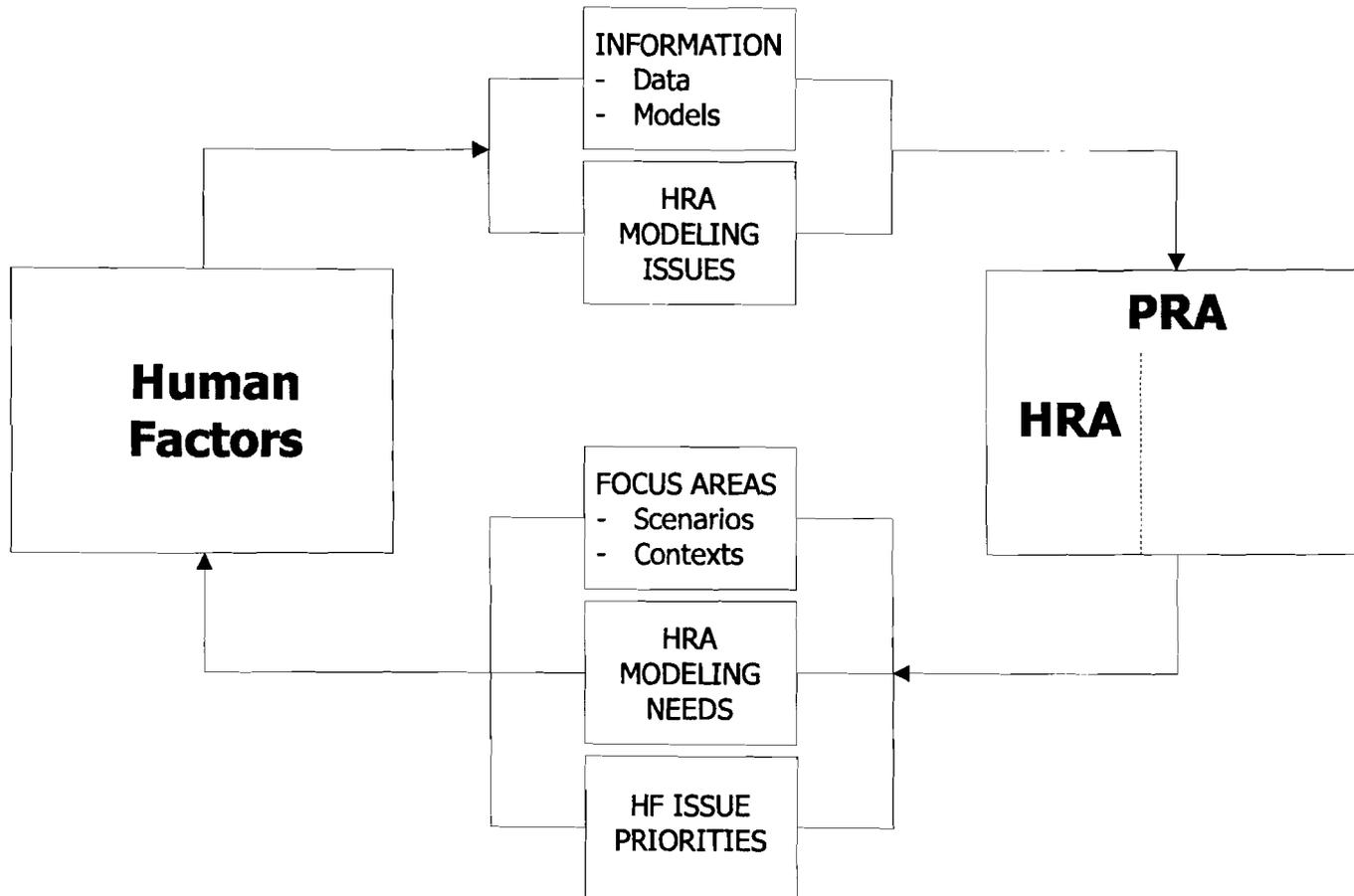
# Briefing Outline

---

- **HRA and HF relationships and interactions**
- **Overall HRA Plan status**
- **Currently planned activities**
- **Specific activities**
  - **Advanced reactors**
  - **Data collection and analysis**

# HRA and HF Relationship

---



# Overall HRA Plan status

---

- **Last update: May 2001**
- **Covers 2001-2005**
- **Some activities near completion**
  - **PTS HRA**
  - **Quantification including uncertainty**
- **Remaining activities underway or planned**
- **Expect plan to be updated, by January 2003**
  - **date/milestone updates**
  - **projects deleted/added**
    - **Vulnerability Assessment**
    - **HRA standards**
  - **5 year**
  - **Broader in terms of activity description**

# HRA Activities

	<b>Conventional Reactors</b>	<b>Advanced Reactors</b>	<b>Materials And Waste</b>	<b>Security and Safeguards</b>
<b>Rules</b>	PTS			Fitness for Duty
<b>Licensing</b>	<ul style="list-style-type: none"> <li>▪ Fire</li> <li>▪ SGTR</li> <li>▪ Aging Cables</li> </ul>	Upgraded & Advanced Reactors	<ul style="list-style-type: none"> <li>▪ Dry Cask</li> <li>▪ Other support</li> </ul>	Vulnerability Assessment
<b>Monitoring</b> (e.g., ROP Event Analysis Issue Identification)	SPAR Models			
<b>Infra-structure</b>	<p><u>Methods and Tools</u></p> <ul style="list-style-type: none"> <li>▪ Data Collection and Analysis</li> <li>▪ Quantification and Uncertainty</li> <li>▪ Latent Errors in HRA</li> <li>▪ Extended Applications:</li> <li>▪ Reactor Synergisms and HRA</li> <li>▪ Formalized Methods: Screening, Individual and Crew Modeling</li> </ul> <p><u>Implementation</u></p> <ul style="list-style-type: none"> <li>▪ Guidance, Standards</li> </ul>			

# HRA for Upgraded and Advanced Reactors

---

- **Objective:** Determine if any improvements are needed to incorporate the influence of human performance in PRAs for upgraded and advanced reactors
- **Potential technical issues**
  - reduced staff, the changing role of the operator
  - new control room design
  - multiple modules
  - long-term recovery
- **Products:**
  - issue identification
  - methods and tools
  - guidance
  - HRA
- **Plan:** initiate work in 2003

# Data Collection & Analysis

---

## ■ Objectives

- Determine data needs for HRA
- Collect and analyze data to support HRA model development and quantification

## ■ Work performed at INEEL

- Funded by HF and HRA Programs
- Currently focuses on needs of the Quantification Task (Sandia)
- Supports/interfaces with CSNI activities on data collection
- Collaborates with Halden

# Data Collection and Analysis

---

## ■ **Approach**

- Characterize the information needed to apply HRA methods and to estimate human error probabilities
  - Identify concepts and terms used in the various methods
  - Determine concept/term commonalties
- Identify and evaluate data sources for usefulness
- Develop methods to utilize information/data
- Develop methods to estimate develop human error probabilities

# Data Collection and Analysis

---

## ■ **Current activities**

- development of glossary is underway
- data sources under examination
  - data in open psychological literature
  - simulator data
- One specific source--data generated for the advanced reactor staffing study will be discussed in some detail today



*United States*

*Nuclear Regulatory Commission*

---

# Human Factors Research at the US Nuclear Regulatory Commission

J. J. Persensky

Office of Nuclear Regulatory Research

Presented to

Subcommittee on Human Factors

Advisory Committee on Reactor Safeguards

USNRC Headquarters • Rockville, MD • 10<sup>th</sup> September 2002

# Role of the Human Factors Research Program at the USNRC

---

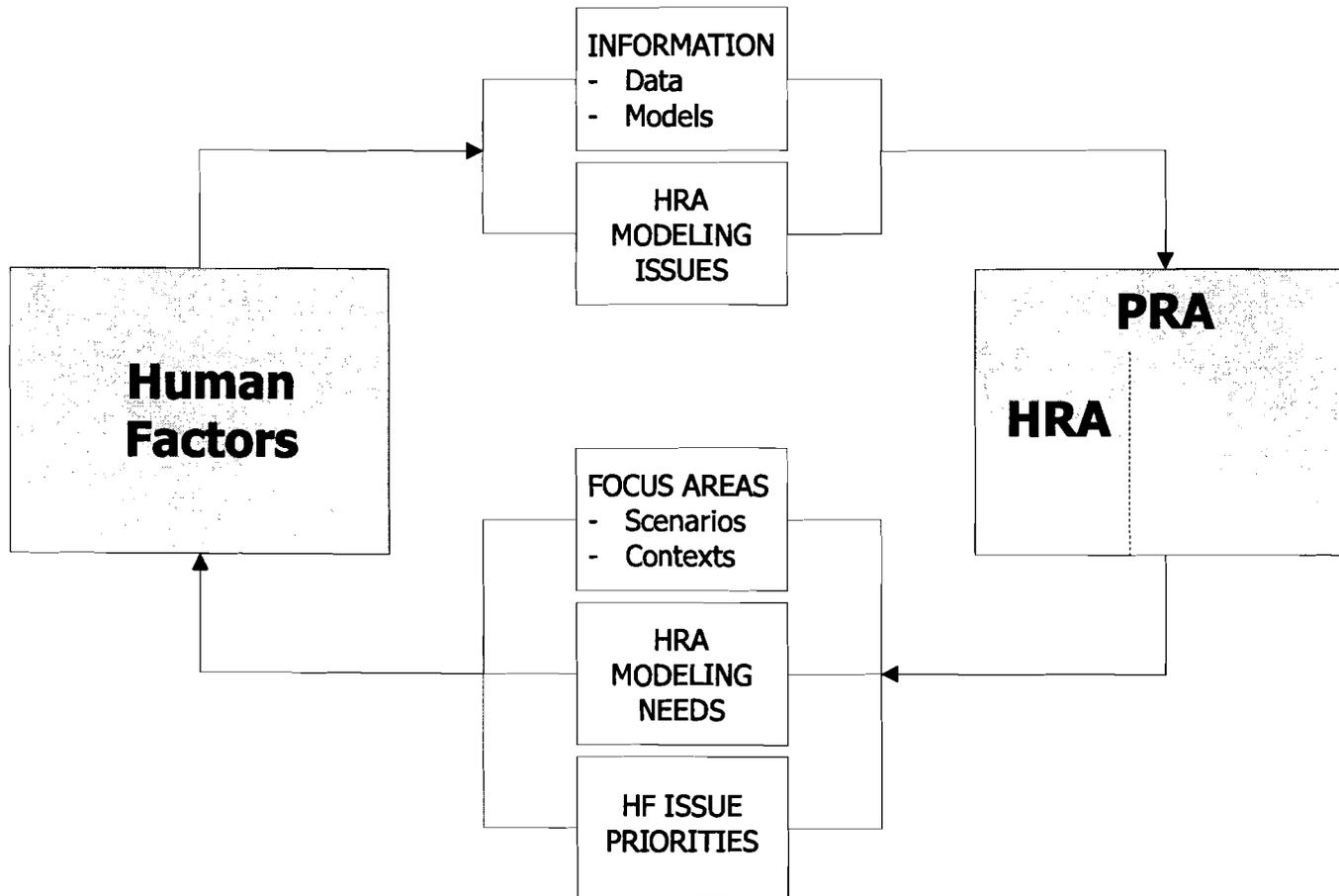
- Provide NRR, NMSS and NSIR staff with tools, developed from the best available technical bases, necessary to accomplish their licensing and monitoring tasks.
- Ensure that nuclear facility personnel have the tools, knowledge, information, capability, work processes and working environment (physical and organizational) to safely and efficiently perform their tasks.

# SECY- 01-0196

---

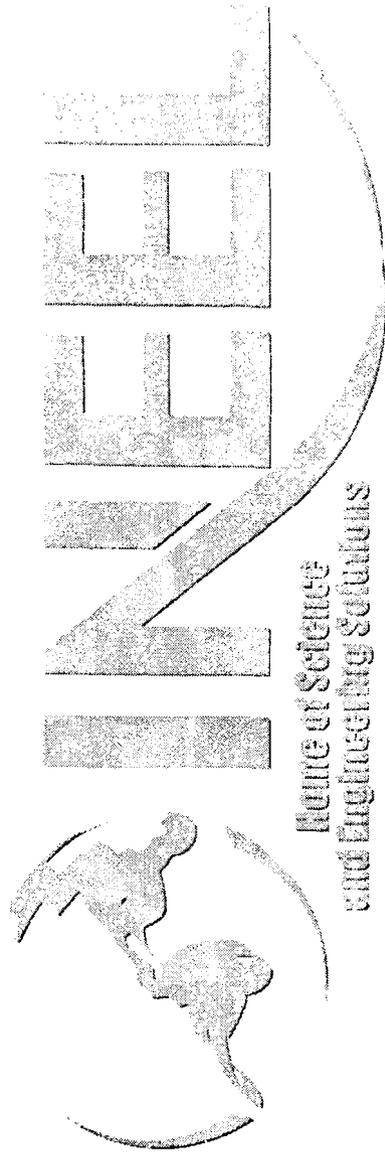
- Sunset the “Program on Human Performance in Nuclear Power Plant Safety” as an independent document
  - RES participation only
  - Limited Resources
- Integrate activities into Human Reliability Research Plan or Digital I&C Research Plan
- Presented status of efforts from SECY-00-0053

# HRA & HF Relationship



# Human Factors Activities and Needs

	Conventional Reactors	Advanced Reactors	Materials	Security and Safeguards
<b>Rules</b>	<u>Fatigue</u>			<u>Fitness for Duty</u>
<b>Licensing</b>	<ul style="list-style-type: none"> <li>▪ <u>SRP Chpt. 18</u></li> <li>▪ <u>Staffing</u></li> </ul>	<ul style="list-style-type: none"> <li>▪ <u>Staffing</u></li> <li>▪ <u>Licensing and Training</u></li> </ul>	<b>SRP</b> <ul style="list-style-type: none"> <li>▪ <b>Development</b></li> <li>▪ <b>Review</b></li> </ul>	
<b>Monitoring</b>	<u>ROP:</u> <b>Risk-inform CAP</b>		<b>Inspection Manual Update</b>	
<b>Infrastructure</b>	<ul style="list-style-type: none"> <li>▪ <b>Data Collection and Analysis</b></li> <li>▪ <u>Halden Reactor Project</u></li> <li>▪ <u>Risk Communications</u></li> <li>▪ <u>HF infrastructure for Advanced Reactors</u></li> <li>▪ <u>Human Factors Role in Security and Safeguards</u></li> <li>▪ <u>Consensus Standards</u></li> <li>▪ <b>International Activities</b></li> </ul>			



*Idaho National Engineering and Environmental Laboratory*

# ***Using Simulators in Human Factors Research***

---

## ***Linking Human Factors and Human Reliability Analysis***

*Bruce P. Hallbert*

*Department Manager*

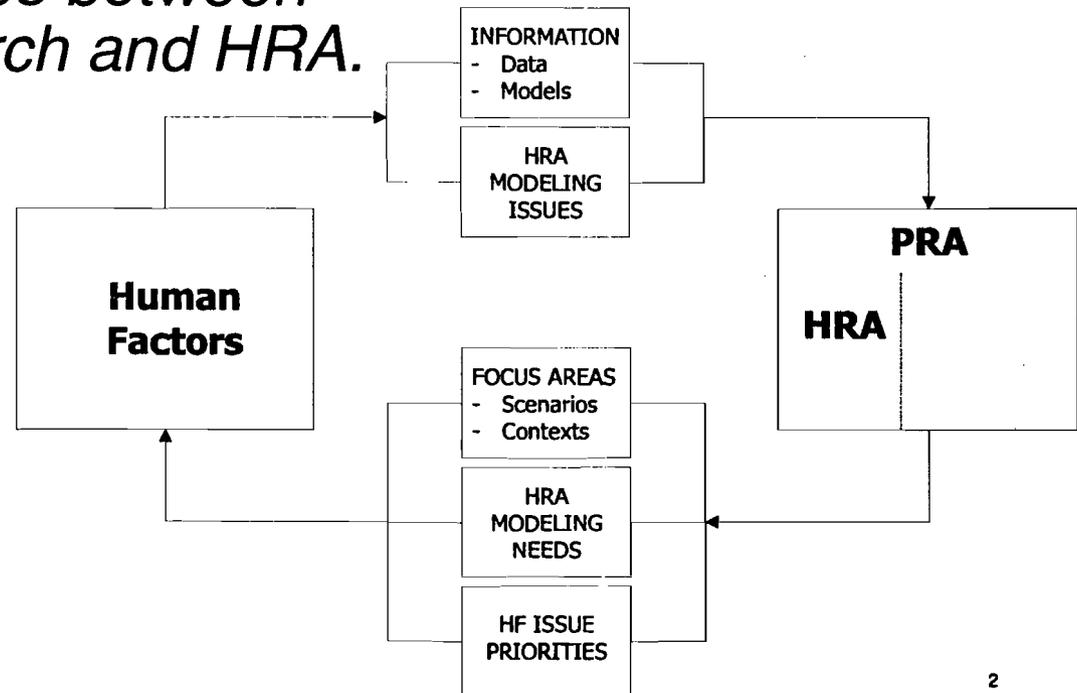
*Human and Intelligent Systems Research*

---

*September 10, 2002*

# Purpose

- *Presents a study of human performance in which data are present to inform HRA activities*
- *Illustrates relationships between human factors research and HRA.*



# Outline

- *Discuss the potential for simulators to support HRA.*
- *Overview of simulator-based research project*
  - *NRC-sponsored staffing study*
  - *Preliminary exploration of PSFs and performance*
- *Summarize results*
- *Discuss potential for HRA*

# ***Developing HRA-Relevant information***

- *Simulator studies can provide useful data for HRA, e.g.,*
  - *Relationships between PSFs, performance, and error*
  - *Hypothesis testing and model development*
  - *Benchmarking HRA methods*
- *Current HRA methods do not make full use of simulator data.*
- *Protocols are needed for collecting data and making inferences to support HRA (number of observations, types of plants, degree of realism, etc.)*

# ***A Study of Control Room Staffing Levels for Advanced Reactors\****

- *Study focused on 10 CFR 50.54 (m) and potential changes to CR staffing of future plants.*
- *Improvements in ease of performance through redundancy, passivity, diversity and automation.*
- *Need to better understand the performance implications of staffing and advanced plant performance.*
- *Conducted study of control room crew performance.*
- *Advanced and conventional plant benchmarks; crew staffing; T-H performance.*
- *Design basis scenarios: SGTR, ISLOCA, LOFW, LOOP, SG overfill.*
- *Evaluate two different CR staffing configurations (normal, minimum)*
- *Carried out at operating NPP training simulator (Loviisa) and advanced plant simulator (HAMMLAB)*

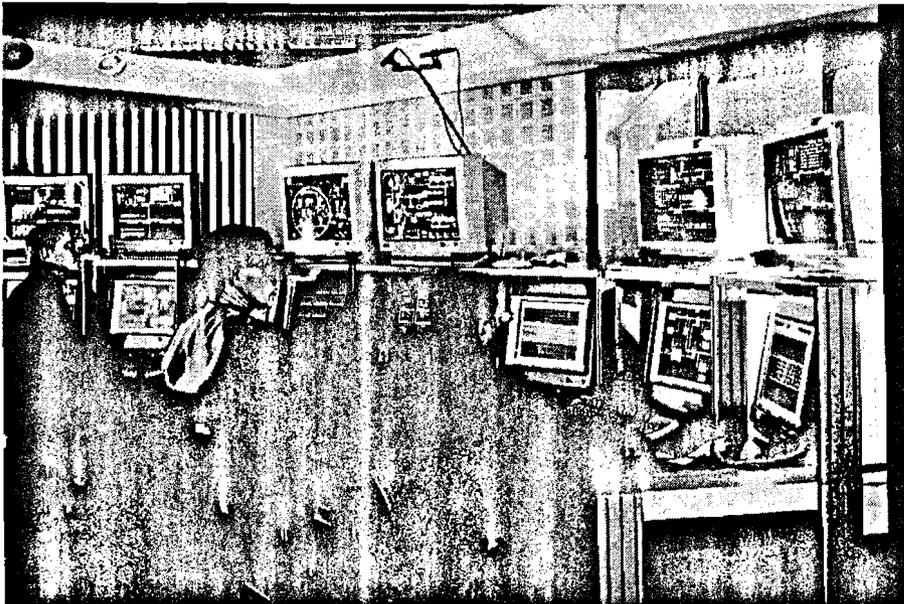
*\*NUREG/IA-0137 (2000)*

# ***Loviisa study phase***

- *Scenarios maximize similarities to Western PWRs (T-H, accident progression)*
- *Crews in study operate as crews in plant.*
  - *training*
  - *role.*
- *EOPs use symptom based approach.*
- *Normal crew = 4*
- *Minimum crew = 3*



# Halden study phase



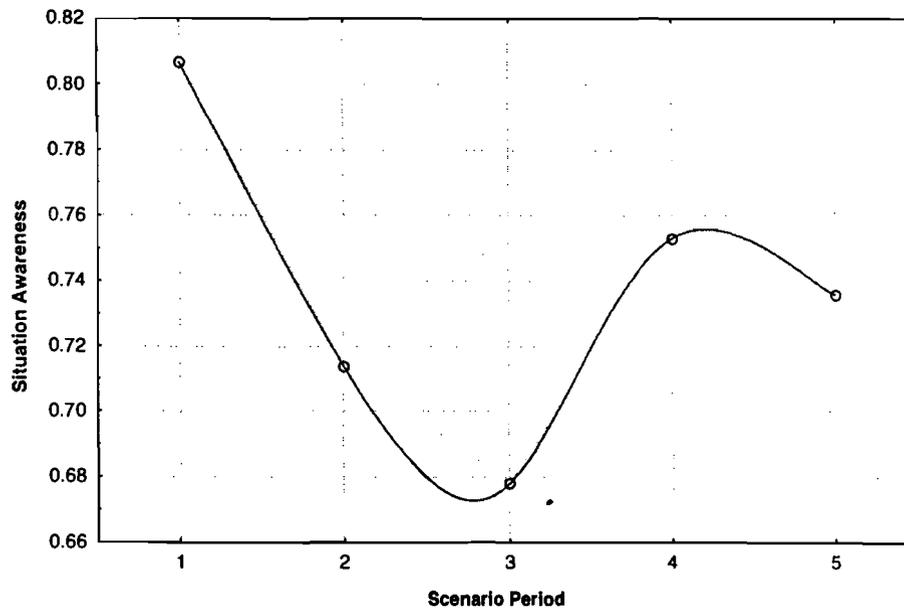
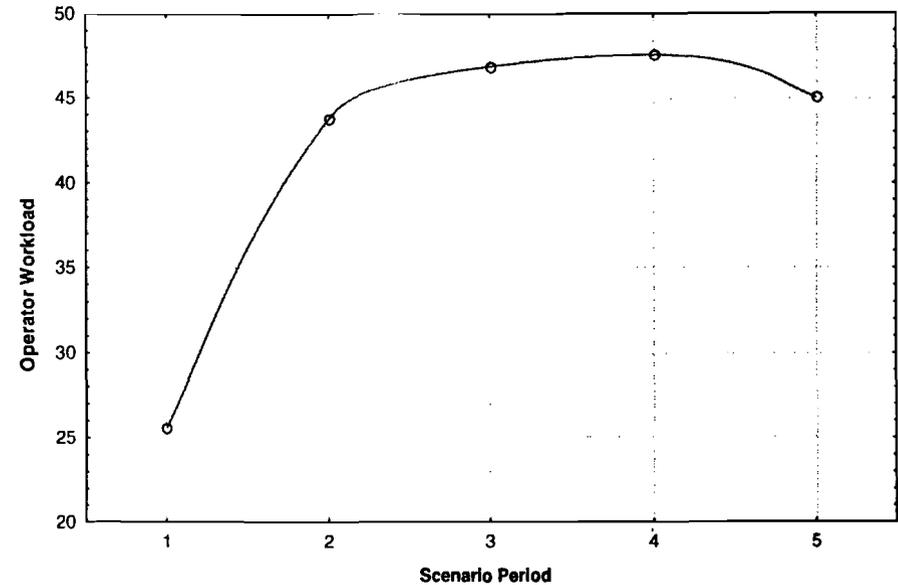
- *Simulated plant based upon Loviisa with added automation to simulate passive system performance.*
- *Digital I&C – Common Overview, Alarms, process displays, SPDS*
- *Workstation arrangement following CR division of labor*
- *Normal crew = 4*
- *Minimum crew = 2 (dual role SS/RO-BOP)*

## ***Data Collection***

- *8 crews presented with 5 scenarios; 4 crews served in normal, 4 crews served in minimum staffing configuration*
- *Data collected on:*
  - *Subjective Workload (NASA TLX)*
  - *Team Performance (BARS)*
  - *Situation Awareness (SACRI)*
  - *Rated crew performance*
  - *Task completion, Plant parameters*
- *First 4 measures collected 4-5 times during each scenario*

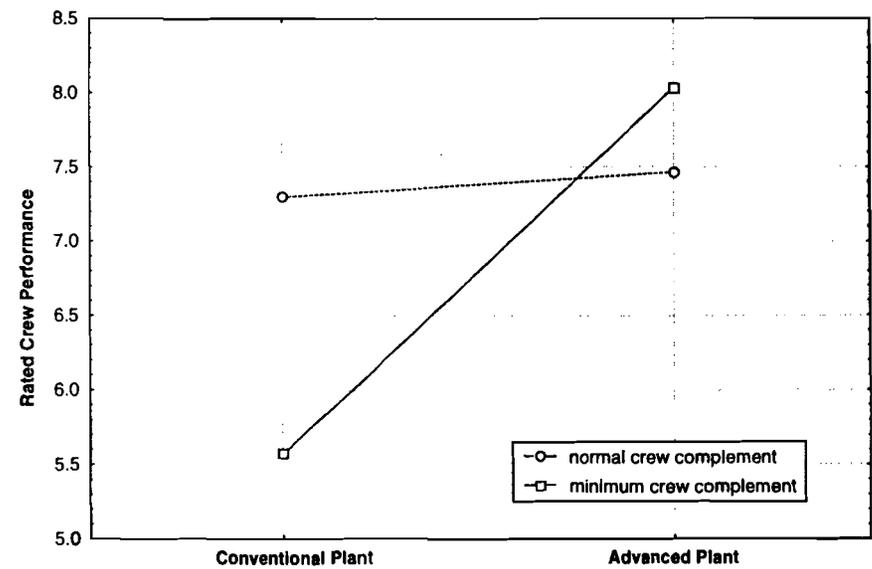
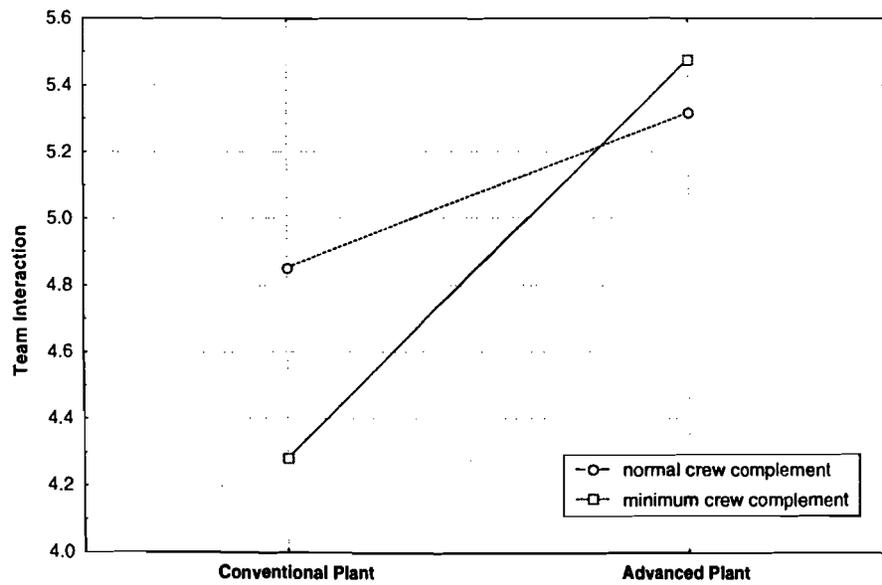
# Results

- Crews experienced high workload for extended periods of time.*      **----->**



- Situation Awareness dropped, followed by gradual recovery*
- ←-----**

- Rated crew performance on transient management activities paralleled ratings of teamwork



# ***Embedded Study : Operator Performance and PSFs***

- *Intuitive linkage between PSFs and operator performance.*
- *Types of PSFs and their effects on error rates vary among HRA methods.*
- *Assessment of PSFs estimated; uncertainty remains high in most applications.*
- *Need for better benchmarking and understanding of PSF relationship with performance.*
- *Linkage needed to build better models of failure.*

## ***Purpose – Embedded study***

- *Explore how data collected in human factors studies could support HRA.*
  - *Identify a set of PSFs that are predictive of crew performance.*
  - *Determine the weighting of these factors relative to one another.*
  - *Demonstrate a general model in which the PSFs can be expressed.*
  - *Measure the factors affecting the predictive validity of PSFs.*
  - *Replicate the results and model developments at different plants and at different times.*

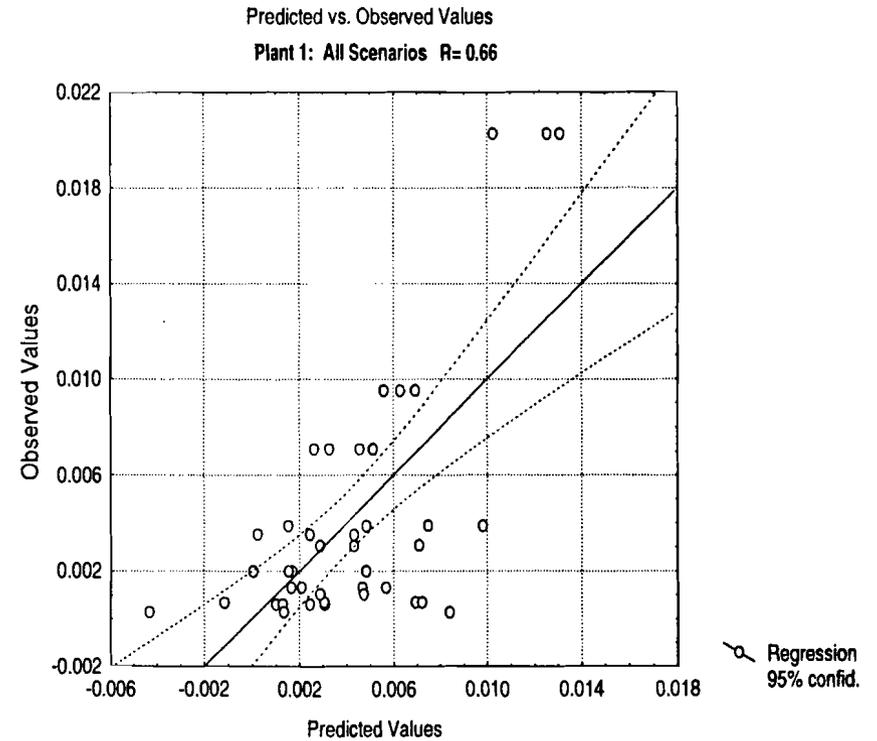
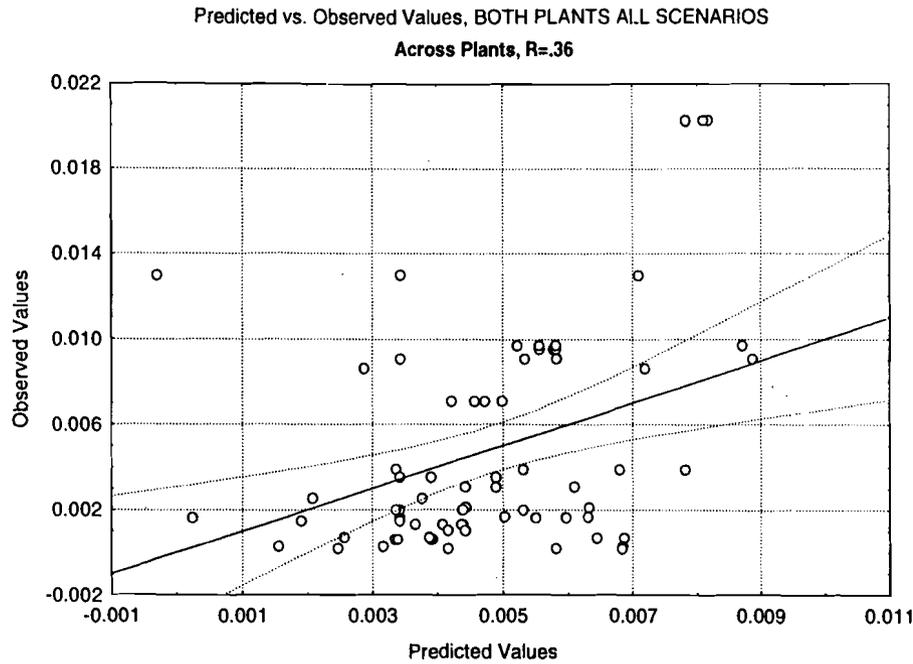
# Approach

- *Set of 10 PSFs tested for use in predicting crew performance:*
  - *7 demonstrated predictive power: Procedures, Training, Stress, Workload, Information Available, System Feedback, HMI.*
- *Data collection instrument developed to measure “experienced” effects of PSFs.*
  - *Critical Tasks (mitigation)*
  - *Simulator trials*
  - *Rating by operators on the effect of PSFs on performance after scenario.*
- *Data collected on:*
  - *4 crews in U.S. plant (3 Scenarios used: LOFW, SG overfill, SB-LOCA) NUREG/CR-4966*
  - *4 crews in Loviisa and 4 crews in HAMMLAB*
  - *3 common scenarios: overheating, overcooling, loss of coolant*

# Results

- *Linear model with combined PSF weightings*
- $$Y = a + b_1x_1 + b_2x_2 + \dots + b_nx_n$$
  - Where  $Y =$  critical task mitigation performance
- *Sensitive to scenario differences*
- *Sensitive to plant differences*
- *Demonstrated predictive ability (critical task performance)*

# Plant-specific predictive power



All crews, all plants, all scenarios

Plant 1, all scenarios

## ***Summary – Embedded Study***

- *Demonstrated link between performance shaping factors and operator performance.*
- *Model, technique show promise for explaining variability in task performance*
  - *Limited to situations in which the defined set of PSFs are, in fact, influencing performance*
- *Potential use for data collection using plant-specific simulators*
  - *Time and training demands are small*
- *No assumptions about strength of relationship between PSFs and performance: empirically established in each data collection trial.*
- *Potential for reducing uncertainty in HRA.*

# Summary

- *Studies have already been conducted, and data collected that can be used to support HRA.*
- *New studies can be aimed specifically at HRA needs.*
- *Simulator studies can provide useful data for HRA.*



*United States*

*Nuclear Regulatory Commission*

---

# Human Factors Research at the US Nuclear Regulatory Commission

J. J. Persensky

Office of Nuclear Regulatory Research

Presented to

Subcommittee on Human Factors

Advisory Committee on Reactor Safeguards

USNRC Headquarters • Rockville, MD • 10<sup>th</sup> September 2002

# Role of the Human Factors Research Program at the USNRC

---

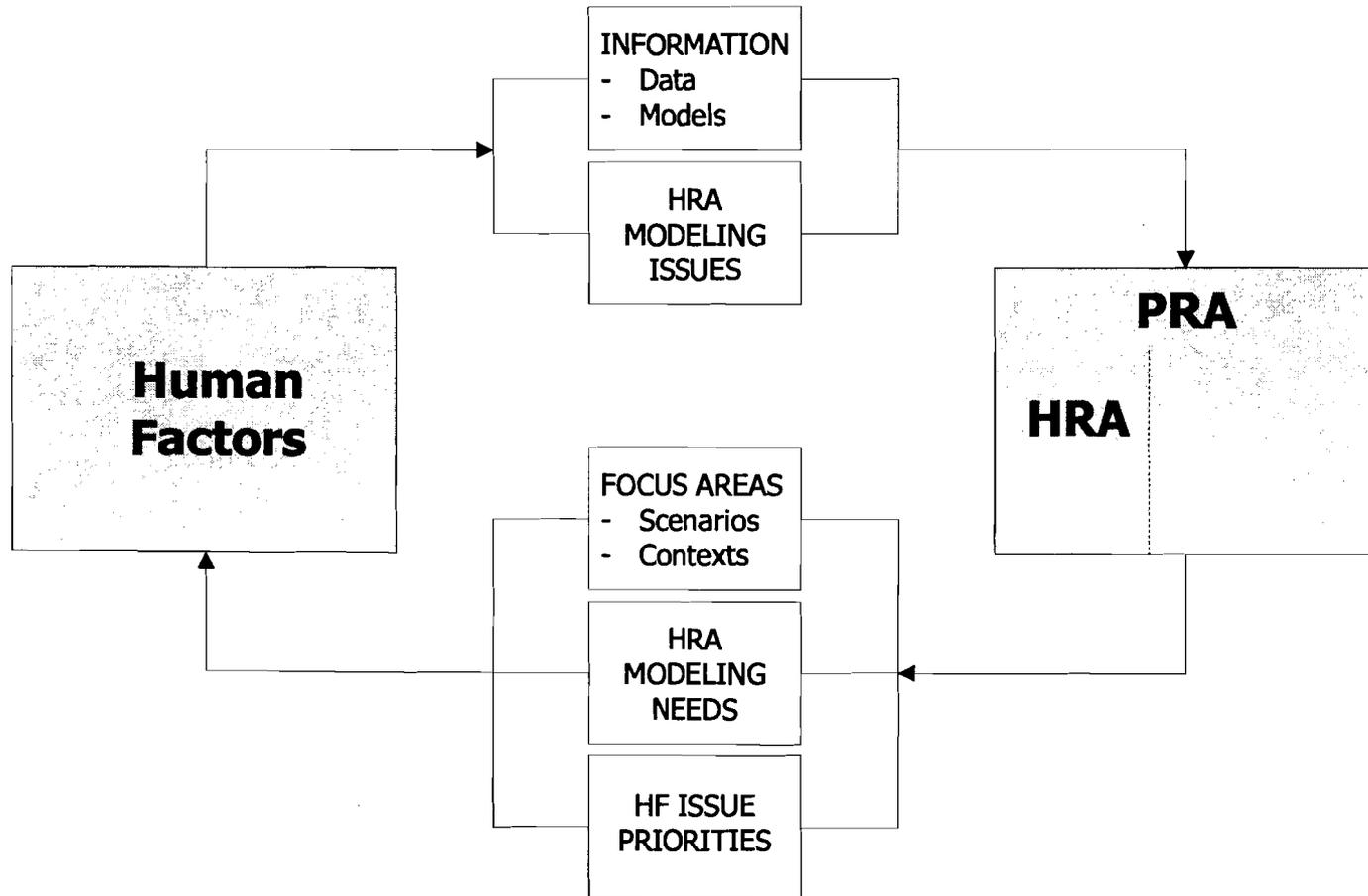
- Provide NRR, NMSS and NSIR staff with tools, developed from the best available technical bases, necessary to accomplish their licensing and monitoring tasks.
- Ensure that nuclear facility personnel have the tools, knowledge, information, capability, work processes and working environment (physical and organizational) to safely and efficiently perform their tasks.

# SECY- 01-0196

---

- Sunset the “Program on Human Performance in Nuclear Power Plant Safety” as an independent document
  - RES participation only
  - Limited Resources
- Integrate activities into Human Reliability Research Plan or Digital I&C Research Plan
- Presented status of efforts from SECY-00-0053

# HRA & HF Relationship



# Human Factors Activities and Needs

	Conventional Reactors	Advanced Reactors	Materials	Security and Safeguards
Rules	<u>Fatigue</u>			<u>Fitness for Duty</u>
Licensing	<ul style="list-style-type: none"> <li>▪ <u>SRP Chpt. 18</u></li> <li>▪ <u>Staffing</u></li> </ul>	<ul style="list-style-type: none"> <li>▪ <u>Staffing</u></li> <li>▪ <u>Licensing and Training</u></li> </ul>	<u>SRP</u> <ul style="list-style-type: none"> <li>▪ <u>Development</u></li> <li>▪ <u>Review</u></li> </ul>	
Monitoring	<u>ROP:</u> Risk-inform CAP		Inspection Manual Update	
Infrastructure	<ul style="list-style-type: none"> <li>▪ <u>Data Collection and Analysis</u></li> <li>▪ <u>Halden Reactor Project</u></li> <li>▪ <u>Risk Communications</u></li> <li>▪ <u>HF infrastructure for Advanced Reactors</u></li> <li>▪ <u>Human Factors Role in Security and Safeguards</u></li> <li>▪ <u>Consensus Standards</u></li> <li>▪ <u>International Activities</u></li> </ul>			



*United States  
Nuclear Regulatory Commission*

---

# NRC Human Reliability Analysis and Human Factors Research Programs: *Overview*

Scott Newberry and Farouk Eltawila

Office of Nuclear Regulatory Research

Presented to  
Subcommittee on Human Factors  
Advisory Committee on Reactor Safeguards  
USNRC Headquarters • Rockville, MD • 10<sup>th</sup> September 2002

# Briefing Objectives

---

- **Provide overview of NRC's human reliability analysis (HRA) and human factors (HF) research programs**
  - **Activities**
  - **Relationship and interactions**
- **Obtain feedback to inform ongoing planning activities**

# Briefing Outline

---

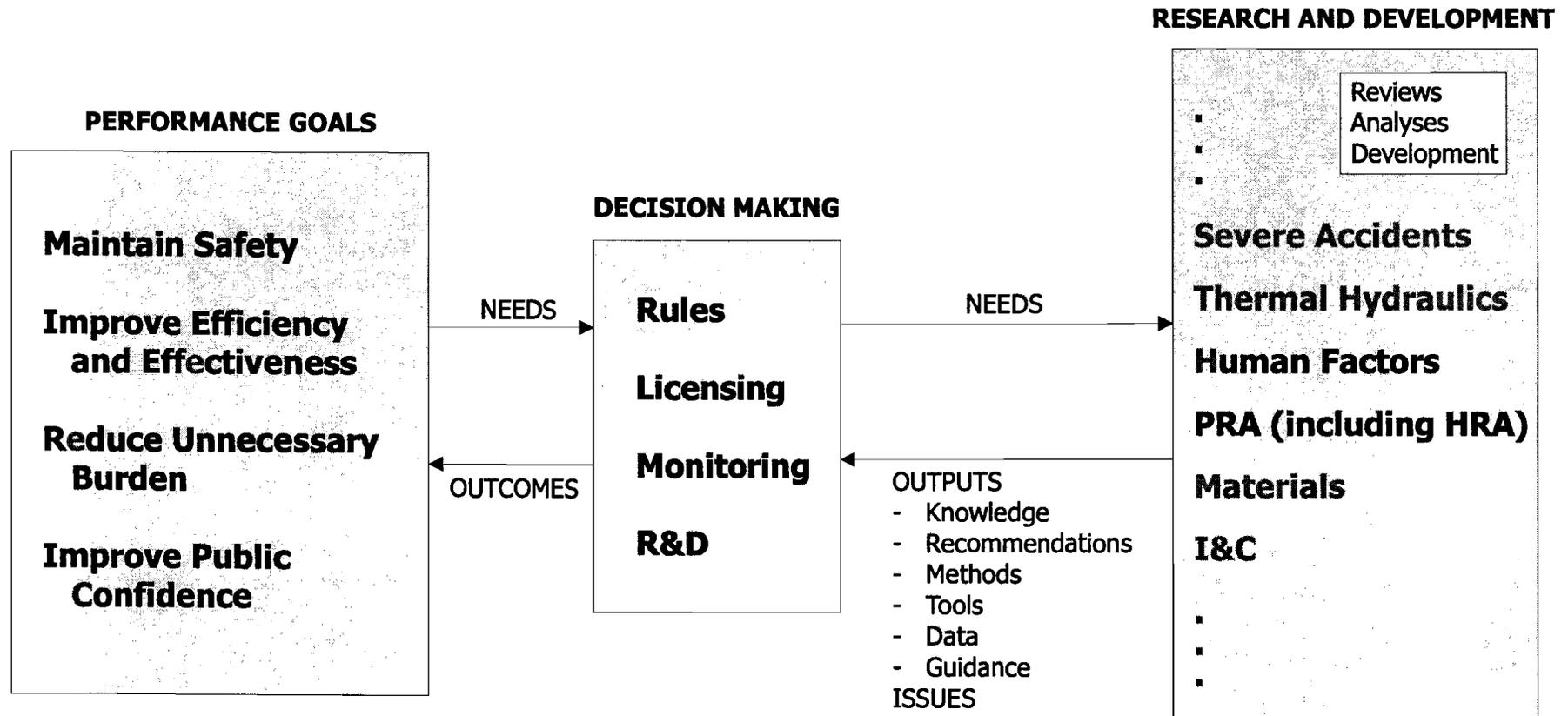
- **Why HRA and HF research and development?**
- **Discipline and program relationships**
- **HRA needs and activities**
- **HF needs and activities**
- **Joint research: a data-collection example**

# Why HRA and HF R&D?

---

- **Agency needs**
- **Operating event experience**
- **PRA experience**
- **Trends and future events**
- **Typical questions**
- **Activity types**

# Supporting Agency Needs



# Programs

---

	<b>Human Factors</b>	<b>HRA</b>
<b>Organization</b>	<b>RES/DSARE</b>	<b>RES/DRAA</b>
<b>Technical Lead</b>	<b>J. Persensky</b>	<b>E. Lois</b>
<b>Plan</b>	<b>SECY-01-0196 (Nov. 2001)</b>	<b>HRA Research Program Plan (May 2001)</b>