NUREG-0985
Rev. 1

U.S. Nuclear Regulatory Commission Human Factors Program Plan

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

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

September 13, 1984

ERRATA SHEET

FOR

NUREG-0985, VOLUME 1

U.S. Nuclear Regulatory Commission
Human Factors Program Plan

August 1983

Please delete Volume 1 from the above report. It is an erroneous identifier. A revision to this report will be done annually.

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NUREG-0985
Rev. 1

U.S. Nuclear Regulatory Commission Human Factors Program Plan

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U.S. Nuclear Regulatory Commission
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FOREWORD

The U.S. Nuclear Regulatory Commission's Policy and Planning Guidance for 1982 (NUREG-0885, Issue 1) called for development of a long range human factors program plan. An initial version of that Plan was issued in July, 1983. The Plan has been further revised to reflect allocations of the estimated FY 1985 budget and to respond to the requirements of section 306 of the Nuclear Waste Policy Act of 1982 (PL 97-425). That revision is presented here as NUREG-0985, Revision 1.

Responsibility for Plan maintenance rests with the Office of Nuclear Reactor Regulation, Division of Human Factors Safety. Project Manager for the Plan is Dr. Daniel B. Jones, Division of Human Factors Safety. It is anticipated that the Plan will be revised on an annual basis. Comments or suggestions for Plan revisions can be sent to Dr. Jones at the following address:

Dr. Daniel B. Jones, Chairman
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Washington, D.C. 20555

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NOMENCLATURE

AEOD	Office of Analysis and Evaluation of Operational Data
AI	Artificial Intelligence
ANI	American Nuclear Insurers
ANS	American Nuclear Society
ANSI	American National Standards Institute
AOP	Abnormal Operating Procedure
BWR	Boiling Water Reactor
CAI	Computer Assisted Instruction
CFR	Code of Federal Regulations
CRGR	Committee to Review Generic Requirements
CRT	Cathode Ray Tube
DFO	Division of Facility Operations
DHFS	Division of Human Factors Safety
DOE	Department of Energy
EDO	Executive Director for Operations
EEI	Edison Electric Institute
EOP	Emergency Operating Procedure
EPRI	Electric Power Research Institute
ERF	Emergency Response Facility
EXAM	Examination
FAA	Federal Aviation Administration
FY	Fiscal Year
HFB	Human Factors and Safeguards Branch
HFEB	Human Factors Engineering Branch
HFRG	Human Factors Review Group
HFS	Human Factors Society
HRS	Human Risk Analysis
INPO	Institute for Nuclear Power Operation
ISD	Instructional System Development
ISEG	Independent Safety Evaluation Group
JPA	Job Performance Aid
LER	License Event Report
LMFBR	Liquid Metal Fast Breeder Reactor
LQB	License Qualifications Branch
LWR	Light Water Reactor
MAN/MACH	Man-Machine
MGMT & ORG	Management and Organization
MMI	Man-Machine Interface
MOU	Memorandum of Understanding
MP	Maintenance Procedure
NASA	National Aeronautics and Space Agency
NMSS	Office of Nuclear Material Safety and Safeguards
NPP	Nuclear Power Plant
NPRDS	Nuclear Power Reliability Data System
NPSRS	Nuclear Power Safety Reporting System
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation

Nomenclature (Continued)

NSSS	Nuclear Steam Supply System
NUMARC	Nuclear Utility Management and Human Resources Committee
OIE	Office of Inspection and Enforcement
O&M	Operations and Maintenance
OL	Operating License
OP	Operating Procedure
OR	Operating Reactor
ORM	Office of Resource Management
PAT	Performance Appraisal Team
PRA	Probabilistic Risk Assessment
PROC	Procedures
PTSB	Procedures and Systems Review Branch
PWR	Pressurized Water Reactor
QA	Quality Assurance
R&D	Research and Development
RES	Office of Nuclear Regulatory Research
RO	Reactor Operator
SALP	Systematic Appraisal of Licensee Performance
SAT	Systems Approach to Training
SPDS	Safety Parameters Display System
SRE	Safety-Related Emergency
SRO	Senior Reactor Operator
SRP	Standard Review Plan
SS	Shift Supervisor
STAFF & QUAL	Staffing and Qualifications
TSD	Training System Development

I. INTRODUCTION

PURPOSE

The purpose of the NRC Human Factors Program Plan (NUREG-0985) is to ensure that proper consideration is given to human factors in the design, operation, and maintenance of nuclear facilities. This revised plan addresses nuclear power plants (NPPs) and describes (1) the technical assistance and research activities planned to provide the technical bases for the resolution of the remaining human factors related tasks described in NUREG-0660, The NRC Action Plan developed as a Result of the TMI-2 Accident," and NUREG-0737, "Clarification of TMI Action Plan Requirements;" (2) the additional human factors efforts identified during implementation of the Action Plan that should receive NRC attention; (3) conduct of developmental activities specified in NUREG-0985 during FY-83; and (4) the impact of Section 306 of the Nuclear Waste Policy Act of 1982, PL 97-425. The plan represents a systematic and comprehensive approach for addressing human factors concerns important to NPP safety in the FY-84 through FY-86 time frame.

BACKGROUND

A thorough understanding of functions, capabilities, and limitations of the personnel involved must be included to evaluate the safety of NPPs. The accident at Three Mile Island Unit 2 (TMI-2), identified the need to bring human factors consideration into the mainstream of NPP regulation and operation. NUREG-0660 described a number of tasks to be performed by the nuclear industry and the U.S. Nuclear Regulatory Commission (NRC). A significant number of these tasks were aimed at improving NPP safety through increased attention to the human element. An analysis of Licensee Event Reports (LERs) indicates that about one third of all reportable events directly involve human performance either as human error or as enhanced safety by effective human performance. Appendix A tabulates those Action Plan items that have been or are being implemented, and those items that are in the process of being resolved as part of this plan.

CURRENT ACTIVITIES

In June and December 1980, the Commission issued Policy Statements augmenting the Commission's regulations with the requirements in NUREG-0737, "Clarification of TMI Action Plan requirements." Currently, licensing reviews have resulted in increased attention having been given to the following human factors areas:

- review of NPP staffing to ensure that the numbers, functions, and qualifications of personnel are adequate for safe operation;
- review of training programs for both licensed and non-licensed NPP staff to ensure that personnel are able to meet existing job performance requirements;

- review of licensing examinations to ensure validity, reliability, and fairness of examinations and the examination process;
- review of procedures to ensure their adequacy and effectiveness;
- review of NPP control rooms and remote shutdown panels to ensure that they are designed to facilitate the man-machine interface (MMI);
- review of utility management and organization to ensure its adequacy to support safe NPP operation;
- review of the impact of human error and human reliability;
- review of the impact of maintenance on NPP operation and safety.

The Commission approved SECY 82-111, "Requirements for Emergency Response Capability." These requirements were published as Supplement 1 to NUREG-0737, and transmitted to the industry as Generic Letter 82-33. This action applies important human factors requirements to operating plants, primarily in the areas of MMI, and upgraded procedures, including training related to these two areas. This effort will be the major focus for human factors activities for operating plants during the next three years. The schedule for accomplishing these activities has been established through negotiation between Office of Nuclear Reactor Regulation (NRR) Project Managers and the utilities.

Section 306 of the Nuclear Waste Policy Act of 1982, PL 97-425, directed the NRC to promulgate regulations or other appropriate guidance for the training and qualifications of civilian nuclear power plant operators, supervisors, technicians and other appropriate operating personnel. In addition, PL 97-425 required NRC to establish simulator training requirements for applicants for operator licenses and for operator requalification programs, requirements governing NRC administration of requalification examinations, requirements for operating tests at civilian nuclear power plant simulators, and instructional requirements for licensee personnel training programs. The impact of Section 306 required significant revisions in the activities and schedules of many Human Factors Program Plan efforts. This revision reflects those changes.

PROGRAM PLAN AND RESOURCES

The Human Factors Program Plan is structured as follows:

- Section I describes the background that led to this plan, current activities, and program management.
- Section II describes a number of special issues which either affect all aspects of the program or require involvement of more than one program element for their resolution.

- Section III addresses the seven major program elements to be addressed in FY-84 through FY-87.

  - Staffing and Qualifications
  - Training
  - Licensing Examinations
  - Procedures
  - Man-Machine Interfaces
  - Management and Organization
  - Human Reliability

Activities planned for these program elements will provide the technical bases for developing guidance for the nuclear industry and will improve the capability of the staff to perform licensing activities effectively. They will also support decisions regarding the degree of regulation required to resolve the technical issues. If the results of the programs indicate that new requirements should be promulgated, such proposals will undergo the normal review process, including review by the Committee to Review Generic Requirements (CRGR).

Appendix A provides the schedule of activities for each of the program elements. Activities are those either planned or underway for NRC Offices and for related major activities initiated at the Institute of Nuclear Power Operations (INPO), the Electric Power Research Institute (EPRI), the Edison Electric Institute (EEI), and the Halden project.

PROGRAM MANAGEMENT, COORDINATION AND INTEGRATION

The success of this human factors program plan relies on effective interactions within the NRC and between the NRC and industry. The systems approach taken in this plan is intended to provide assurance that NRC human factors activities are appropriately integrated and that adequate and accurate human factors information is developed. The plan recognizes that activities initiated within INPO, EPRI, EEI, Owners' Groups, and individual utilities often provide essential information to complement the activities described. To assure that available information is effectively and efficiently used, these activities, and those at other federal agencies and in foreign countries, will be coordinated and integrated with those described in this plan. Memoranda of Understanding (MOU) with INPO have been signed for those industry activities which will affect staff efforts.

Interaction between NRR, RES, and other NRC Offices, NRC contractors and the industry is also necessary to ensure program success. Each program element is reviewed at a working level meeting held quarterly to ensure that the programs identified in this plan are fulfilling the objectives of this plan. These

meetings provide a mechanism to enhance the integration of all activities. The Human Factors Program Plan is updated, formally, at least once a year. This will be prior to the initiation of the annual budget cycle. Specifically, the following program management activities are conducted:

- Three program reviews will be conducted each year at approximately four month intervals: October, February and June.

- Branch Chiefs will present the status of their respective programs.

- The October review is the yearly updating of projects accomplished during the prior fiscal year. The status of ongoing projects and current plans for the next fiscal year, consistent with available budget and resources, will be presented.

- The February review is a status update and will include a discussion of any identified requirements for new or revised projects for future fiscal years. The results of this review will be the annual revision of the Human Factors Program Plan.

- The June review emphasizes accomplishments and will finalize information and data collection needed to update the Human Factors Program Plan for the upcoming fiscal year.

- The principal program plan reviewers will be the Director, DHFS and the Director, DRA. Senior staff members will be included.

- Industry representatives with programs relevant to the plan (e.g., INPO and EPRI) are invited to attend and participate. They will be asked to report the status of their programs such as job/task analyses, maintenance programs, accreditation of training, and management and organization practices.

The Director, NRR has overall responsibility for assuring that the NRC Human Factors Program Plan is properly executed. To assist the Director in his responsibilities, a Human Factors Review Group (HFRG) has been established. The HFRG includes representatives from the Offices of Nuclear Reactor Regulation, Nuclear Regulatory Research, Nuclear Materials Safety and Safeguards, Inspection and Enforcement, Analysis and Evaluation of Operational Data, and Resource Management, a Region representative, and representatives from the staff of the Executive Director for Operations. The HFRG is chaired by the NRR representative. The Director, NRR is responsible for implementing the plan for NPPs. Implementation of the plan for fuel cycle facilities is the responsibility of the Director, NMSS. The human factors research program required to meet user needs is the responsibility of the Director, RES. The research will be carried out in accordance with the February 3, 1982 established procedures for the NRC research process. A quarterly staff report is prepared for the Commission which includes the status of and schedules for those plan activities that include development of specific regulatory documents, a comparison of planned and expended staff resources, and a discussion of accomplishment vs. planned efforts.

II. SPECIAL ISSUES

Several substantive concerns and issues have been identified and are discussed below. These issues will have varying degrees of impact on all the programs described in Section III.

A. Prioritization

The staff recognizes that there must be orders of priority among the plan elements, and among activities of individual elements. While all plan elements and activities are important, some have more immediate application to improved plant safety, or result in products which are essential to the conduct of related plant activities. Among the eight plan elements, top priority is assigned to the training, staffing and qualifications, licensing examination, and maintenance elements. Within each element, priorities have been assigned to the planned activities and to the end products of that element. In general, activities and end products associated with regulatory actions will be given top priority.

B. "Hardware" vs. "Training/Procedures" Solutions to Problems

Frequently, solutions to design-related human factors problems in operating NPPs are based on people-oriented changes (e.g., modifications to operator training or procedures). While this may be an appropriate resolution of some issues, overuse of this approach may overload both operators and operator training programs. Any decisions to adopt training as a solution to a safety issue instead of a design modification must recognize and incorporate the continuing cost of expanded training, increase of crew size, and increase in number of shifts in the cost/benefit evaluation.

C. Maintenance

The primary issue in the maintenance area is one of determining the need for and extent of regulatory involvement by NRR. The NRC is currently developing a Maintenance and Surveillance Program Plan which considers maintenance and possible regulation action. Risk studies, maintenance assessment activities, and incidents at NPPs have established the importance of maintenance to safety. The Maintenance program plan activities will address design for maintainability, personnel qualifications and training, preventive maintenance, maintenance work authorization and control, outage planning and management, inventory control, and management of maintenance activities. Results of these activities will indicate the extent to which regulatory attention should be focused on maintenance. When the Maintenance and Surveillance Program Plan is approved those human factors aspects of maintenance will be included as a Maintenance element of the Human Factors Program Plan.

D. Simulators

Simulators are used throughout the industry for training operators. In response to PL 97-425, examinations at simulator facilities will be required for initial and requalification examinations. A clear regulatory position on the role of simulators, and their required level of fidelity to control room and plant

design for examination purposes, is being established. Such a position including regulatory guidance on the use of simulators in examinations is being developed in the program plan element, Licensing Examination.

E. Probabilistic Risk Assessment (PRA)

Human reliability data and techniques for assessing risk during NPP operations and maintenance activities are limited. Where such data and techniques exist in other fields (e.g., military, aerospace), their applicability or adaptability to a NPP setting are unknown and difficult to verify. RES has ongoing and planned research on methodologies and techniques for collecting credible NPP human error data from operating plants, training simulators, expert judgment and computer simulations; for storing, updating and retrieving human error data; and for applying NPP human error data in human risk analysis (HRA) segments of PRAs. Methods and techniques for substantially improving collection and use of NPP human error data in HRA segments of PRAs are emerging from this research during the FY 1983 through FY 1986 time frame.

F. Advanced Technologies

Existing nuclear plant designs are currently being modified to make use of advanced technologies. Additional modifications are expected to be introduced, based on these and on developing technologies. Supplement 1 of NUREG-0737 requires that a safety parameter display system (SPDS) be provided in plant control rooms. Most of the SPDS designs are based on computer technology and cathode-ray tube (CRT) display techniques. Since these technologies are being introduced into existing NPP designs, it is anticipated that these expanded data and information management capabilities will be applied to other plant processes. As these new control and display technologies are being developed, guidance pertinent to the interface between them and the operator will be developed. The development of computer applications and Artificial Intelligence (AI) capabilities will effect process control and operating and maintenance procedures.

G. Human Factors Aspects of Quality Assurance

The NRC was directed by Congress in Section 13(b) of Public Law 97-415 (the NRC Authorization Act for fiscal years 1982 and 1983) to conduct a study of existing and alternative programs for improving quality assurance and quality control in the construction of nuclear power plants. In SECY-84-124, the NRC staff reported to Congress the results of that study. The staff is currently preparing a Quality Assurance implementation plan which is due to the Commission in September 1984. Human Factors issues are also related to quality assurance (QA) in many ways. Adequate staffing and qualifications of QA personnel in NPPS, training in QA for NPP personnel and NRC inspectors, procedures to be used to assure quality, human engineering of QA inspection techniques and test equipment, and management of QA, all involve human factors considerations. When the QA implementation plan is approved the appropriate human factors aspects of quality and quality assurance will be included as part of this Human Factors Program Plan.

H. Nuclear Industry Management Initiatives

The Nuclear Utility Management and Human Resources Committee (NUMARC) was established by the utility industry in April 1984 with an objective of improving performance of nuclear power plant personnel and management. NUMARC activities will need to be incorporated in the HFPP, especially the program elements for Staffing and Qualifications, Training, and Management and Organization. Initiatives by NUMARC will be included in the Plan as they are developed and will be included in more detail in the next revision of the Plan.

I. Implementation

Schedules for human factors program plan activities (Appendix A) leading to regulatory end products reflect only the staff's development efforts associated with these products. The usual end products of these activities will be recommendations for or against specific regulatory positions, a proposed regulatory guide or a proposed rule. A range of administrative processes and procedures will then be required before these end products can be implemented.

III. PROGRAM ELEMENTS

A major purpose of this Human Factors Program Plan is to develop the technical basis for establishing human performance criteria to support regulatory decisions. The NRC, EPRI, EEI, INPO, Department of Energy (DOE), organizations in foreign countries, and individual utilities are all collecting data and information that will be useful. This section describes the NRC efforts for FY-84 through FY-86 to develop the technical bases for regulatory review of NPP Staffing and Qualifications, Training, Licensing Examinations, Procedures, Man-Machine Interface, Management and Organization, and Human Reliability. If results of the programs indicate that new requirements should be promulgated, such proposals will be carefully considered and subjected to all regulatory review processes. Schedules for the program elements are shown in Appendix A. The numbering system of this Section corresponds to that of Appendix A.

1. Staffing and Qualifications

The goal of this element is to ensure that staffing is adequate for safe operation and support of NPPs. This goal will be met by developing guidelines and regulatory requirements addressing (1) the numbers and functions of NPP staff needed to safely perform all required plant operations; (2) the minimum qualifications of plant personnel, in terms of education, skill, knowledge, training, experience and fitness for duty; and (3) appropriate limits and conditions for shift work including overtime, shift duration, and shift rotation.

On January 7, 1983, the Nuclear Waste Policy Act of 1982 was signed into law (Public Law 97-425). Section 306 of the Act directed the NRC to promulgate regulations and guidance on the training and qualifications of NPP personnel. The planned activities and end products of this element have been adjusted to support development of proposed new requirements.

The benefits which result from accomplishing the goal are:

- optimum NPP personnel staffing based on operating needs and emergency resource requirements
- reduced risk to the public by reducing human error through improving capability of NPP personnel to respond to unanticipated events;
- reduced risk to the public by reducing human error through improved work scheduling activities.

The issues in this element are:

- the possible impact on safety due to the lack of sufficiently qualified individuals;
- the need for a technical basis for use in developing requirements on experience and education (e.g., need for college degrees for nuclear power plant personnel);

- the need for methods to evaluate licensees' proposed staffing and qualifications programs.

1.1 NPP Staffing Requirements

In order to determine the appropriate minimum shift staffing requirements for NPP personnel, the following activities will be performed:

- develop a method to determine shift crew staffing requirements. The method will establish staffing criteria from a systematic analysis of the functional requirements of the control room tasks and the operator action event sequences as defined by Level II PRA. A workbook or checklist for the application of the method to evaluate staffing levels will be developed for NRC use. (RES) (Medium Priority);

- based on the results of the development of criteria for evaluating shift crew staffing levels, the feasibility of using manpower projection modeling techniques to determine optimum NPP staffing levels will be investigated. (NRR/RES) (Medium Priority);

1.2 NPP Personnel Qualifications Requirements

In order to determine the appropriate minimum qualification requirements for NPP personnel, the following activities will be performed:

- evaluate job/task analysis data to determine knowledges, skills and abilities needed to perform jobs and establish minimum personnel qualifications requirements. (RES and industry) (High Priority);

- conduct simulator experiments and field data collection on operating crew response to normal, off-normal and emergency conditions to identify the effect of crew member qualifications on job performance. (RES) (High Priority);

- determine effectiveness of engineering expertise on shift as implemented by the policy statement. (NRR) (High Priority);

- identify job-related qualifications for the operations shift crew. (NRR) (Medium Priority);

- evaluate the feasibility and value of licensing or certifying NPP personnel other than licensed operators. (NRR) (Medium Priority);

- develop a regulatory position for licensing or certifying personnel other than licensed operators. (NRR) (Medium Priority);

- develop rule on degree requirements for operating staff (NRR) (Medium Priority);

- revise and evaluate changes to Regulatory Guide 1.8. (NRR/RES) (High Priority);

- develop a means to evaluate the acceptability of NPP personnel qualifications programs. (RES) (Medium Priority);

- develop guidance and/or regulation concerning operating experience on shift. (NRR) (High Priority).

1.3 Guidance on Limits and Conditions of Shift Work

At this time, the effects of different shift rotation schedules have not been identified as a significant cause of performance decrement or unique human error. A specific research project to evaluate shift rotation effects will be planned if shift rotation is found to be a source of serious human factors problems. In order to determine the appropriate limits and conditions of shift work, the following activities are planned:

- survey and assess experience of other industries which have job requirements similar to the nuclear industry with regard to shift duration, shift arrangements and rotations on personnel performance (NRR/RES) (Medium Prority);

- evaluate the current NRC policy statement on overtime (NRR) (Medium Priority);

- prepare a policy statement or limits and conditions of shift work (NRR) (Medium Priority).

1.4 Fitness for Duty

Revise 10 CFR 50.54 to include fitness for duty and revise 10 CFR Parts 50 and 73 ("Insider Rule") (RES) (Low Priority).

1.5 Industry Activities

INPO's survey of industry staffing levels and its program on job/task analysis for operating and support personnel provide a data source for developing criteria for personnel staffing levels. EEI has completed work on selection testing instruments for NPP operators which will be used in NRC efforts on qualifications. An industry committee (ANS 3.1) is also developing recommendations on staffing and qualifications.

1.6 End Products

The products of the activities outlined in this element are:

- a policy statement on engineering expertise on shift (FY-85) (High Priority)

- revision of Regulatory Guide 1.8, "Personnel Qualification and Training" (FY-85) (High Priority);

- a rule on degree requirements for a member of the shift staff (FY-85) (High Priority);

- a rule or guidance on operating experience on shift (FY-86) (High Priority);
- a rule on fitness for duty (FY-84) (Low Priority);
- a regulatory position regarding licensing/certification of others (FY-86) (Medium Priority);
- a revised Standard Review Plan for staffing and qualifications (FY-86) (Medium Priority);
- assessment criteria and guidelines for NPP personnel staffing qualifications (FY-86) (Medium Priority);
- a report on job-related qualifications of operating shift crews (FY-85) (Medium Priority);
- a rule revising 10 CFR Part 73 (FY-86) (Low Priority).

Figure III-1 describes the sequence of activities leading to these end products.

1.7 Responsibility

The responsibility for implementation of the activities described in this program element is divided. The Chief, Licensee Qualifications Branch (LQB), NRR, is responsible for the conduct of all NRR activities listed in Sections 1.1 through 1.4, identifying research and standards needs to assist in implementing the regulatory process, identifying required dates for products from research for standards, and managing the NRR technical assistance program. The Chief, Human Factors and Safeguards Branch, RES is responsible for developing and managing the research to meet NRR requirements and for delivery of the products in a timely manner consistent with quality and programmatic constraints. The research will be carried out in accordance with the February 3, 1982 established procedures for the NRC research process.

2. Training

The goal of this element is to provide means for ensuring that nuclear power plant personnel are able to meet job performance requirements and that a mechanism exists for assessing and improving the quality and effectiveness of training programs. This goal will be met by (1) promulgation of a proposed training and qualifications rule with supporting regulatory guidance, and (2) development and implementation of reliable, objective procedures for use by NRR and the Regions in inspecting training programs. The Nuclear Waste Policy Act of 1982 Section 306 (PL 97-425) directed the NRC to promulgate regulations and guidance for the training of nuclear power plant personnel. A rule and regulatory guidance have been proposed (SECY 84-76) to respond to that mandate. Section 306 of PL 97-425 further requires that the NRC address simulator training requirements, operator requalification programs, instructional requirements for training programs, and the administration of examinations. The concept underlying the proposed rule, the Systems Approach to Training, provides a logical method of integrating the major aspects of all the areas to be addressed.

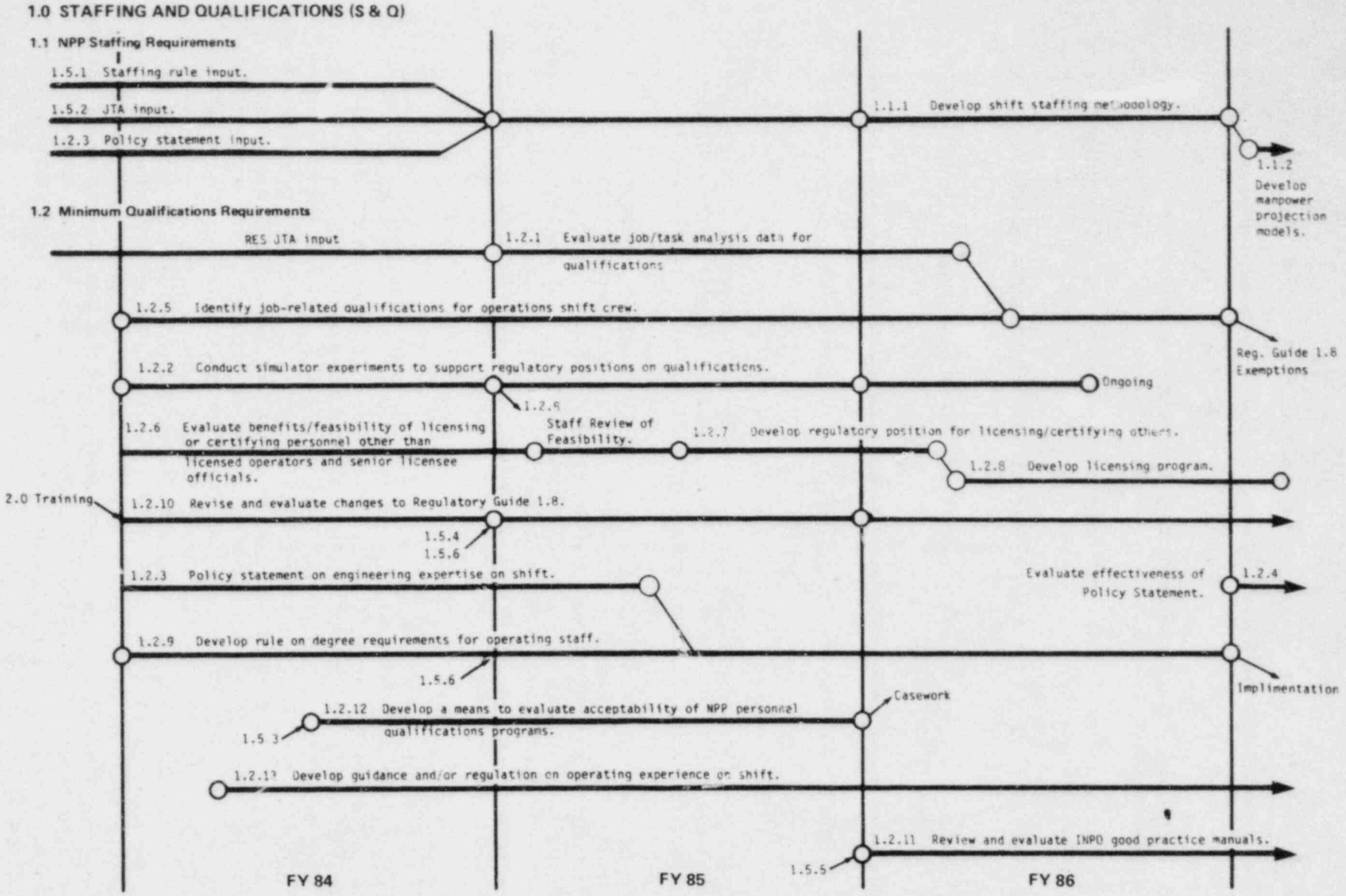

Figure III: 1.0 Staffing and Qualifications Activity Sequence Diagram

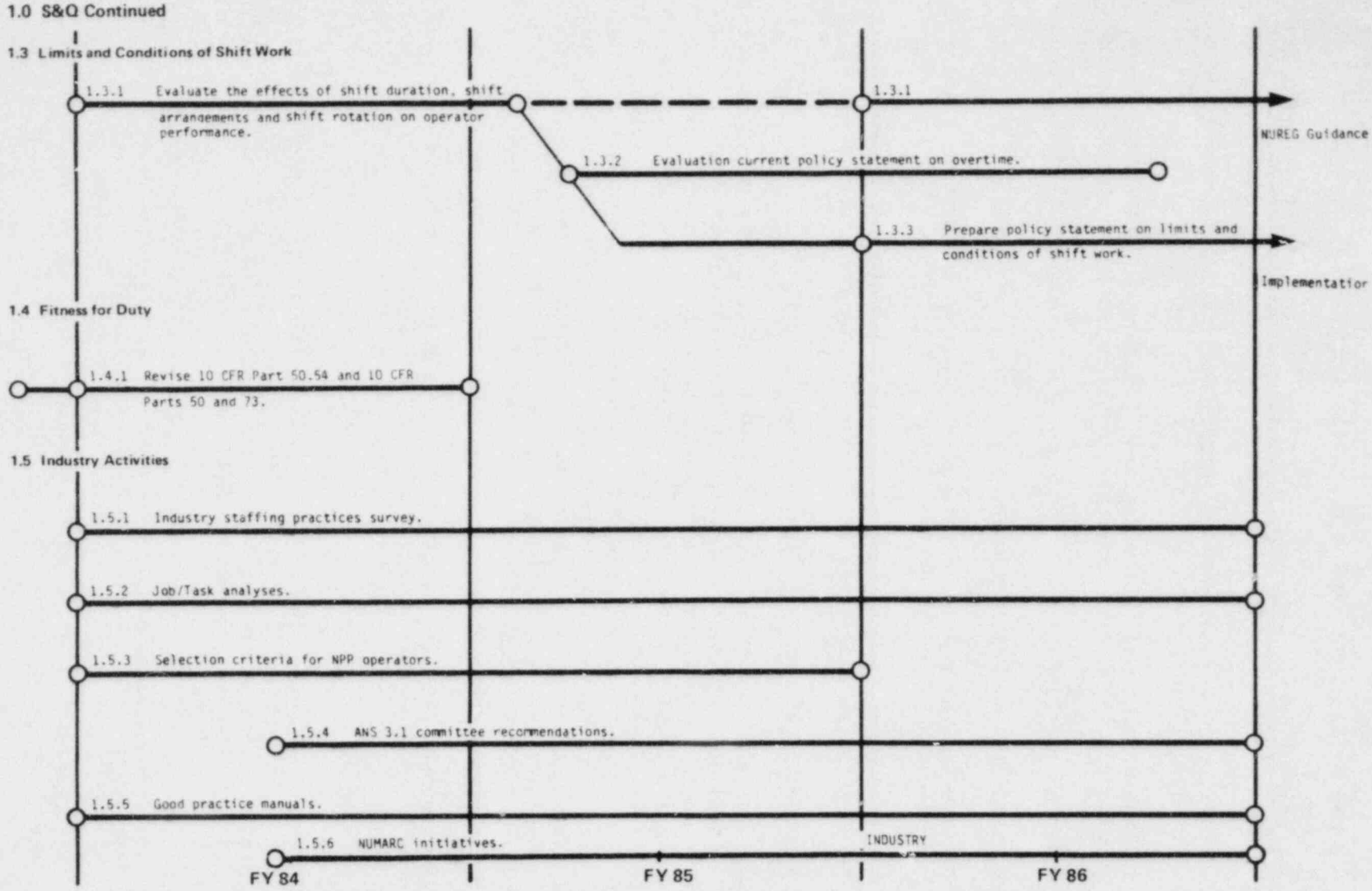

Figure III: 1.0 Staffing and Qualifications Activity Sequence Diagram

Benefits anticipated as a result of accomplishing this goal are:

- reduced human errors during operation and maintenance;
- increased licensed operator knowledge, skill, and ability necessary to respond to unexpected events;
- improved effectiveness and efficiency of licensed and non-licensed training programs;
- increased focus by utility training programs on performance-based knowledges, skills and abilities required to safely operate the NPP;
- improved audit trail and methodology for evaluating training programs.

Issues associated with this element are:

- difficulties of meeting accelerated schedules for promulgation of the rule and regulatory guidance;
- resolution of the question of the extent to which INPO Accreditation can be an acceptable alternative for meeting the requirements of the rule.

2.1 Development of Training Regulation and Guidance

In response to PL 97-425 Section 306, NRR has developed a proposed regulation (SECY 84-76) and regulatory guidance for the training and qualifications of civilian nuclear power plant operators, supervisors, technicians and other appropriate operating personnel. The proposed regulation directs the utilities to use a Systems Approach to Training (SAT) in developing revisions to their training programs. In addition, NRR has developed a proposed Regulatory Guide which discusses the essential elements of SAT. Implementation requirements for the proposed rule and the accompanying regulatory guidance recognize the relationship to INPO's training accreditation effort and INPO's ongoing effort to develop detailed guidance on implementation of the SAT process. The following activities are planned:

- development of a training regulatory package to implement Section 306, PL 97-425, to include revisions to 10 CFR Part 50, a training regulatory guide on the application of SAT to NPP training and revisions to Regulatory Guide 1.8 (NRR/RES) (High Priority);
- develop and publish a NUREG for team training (NRR) (Low Priority);
- determination of the qualifications needed and a regulatory position for utility Training Instructors (NRR) (Medium Priority);
- based upon job and task analysis data, review existing training requirements to eliminate excessive regulatory requirements (NRR) (Medium Priority);
- conduct operator personnel task analyses and analyze collected data to determine the need for training regulation (RES) (Medium Priority);

- identify training needs of operators for accident management (RES) (High Priority);

- conduct simulator experiments to support regulatory positions on training (RES) (Low Priority).

2.2 NRC Training Evaluation Program

In order to provide adequate criteria and procedures for enforcement of the proposed training rule (SECY 84-76), the following activities are planned:

- development of training evaluation procedures derived from SAT. (NRR) (High Priority);

- development of revised inspection modules incorporating the new training assessment criteria for use by Regional Offices. (NRR/OIE) (High Priority);

- revision of SRP Chapter 13.2 for use by NRC staff in evaluating training programs for applicants for operating licenses. (NRR) (Medium Priority);

- evaluation of NRC's position with respect to INPO's Accreditation Program. (NRR) (High Priority);

- development of audit procedures to monitor Accreditation effectiveness. (NRR) (High Priority).

2.3 Industry Activities

INPO has undertaken a major program to ensure the adequacy of utility training programs. This effort has resulted in the establishment of a training accreditation process designed to upgrade the quality of utility training programs. INPO has also developed technical reports presenting guidelines and criteria for training and qualifications of both licensed and non-licensed NPP personnel. INPO's job/task analysis identifies knowledges and skills to be used as the foundation for the development of curricula for training programs for licensed and selected non-licensed personnel. INPO is also preparing a handbook for industry trainers which is to be used in developing training programs based on a SAT.

2.4 End Products

The end products of the training program element include:

- a training rule (10 CFR Part 50) for the training of NPP personnel (FY-85) (NRR) (High Priority);

- Regulatory Guides (X.XX and 1.8) to accompany the proposed training rule (FY-85) (NRR) (High Priority);

- NUREG for Team Training (FY-85) (NRR) (Low Priority);

- criteria for evaluating industry training programs for NPP personnel (FY-86) (NRR) (High Priority);

- determination of facility Training Instructor qualifications and NRC regulatory position (FY-86) (NRR) (High Priority);

- input to revision of ANSI/ANS 3.1 (FY-85) (NRR/RES) (Medium Priority);

- revised Chapter 13.2 of NUREG-0800, "Standard Review Plan" (SRP), (FY-86) (NRR) (Medium Priority);

- revised OIE Inspection modules (FY-86) (NRR/OIE) (High Priority);

- an NRC position with respect to accreditation (FY-85) (NRR) (High Priority);

- accreditation audit procedures (FY-86) (NRR) (High Priority).

Figure III-2 describes the sequence of activities leading to these end products.

2.5 Responsibility

The responsibility for implementation of the activities described in this program element is divided. The Chief, LQB, NRR, is responsible for the conduct of all NRR activities listed in Sections 2.1 and 2.2, identifying research and standards needs to assist in implementing the regulatory process, identifying required dates for products from research and for standards, and managing the NRR technical assistance program. OIE is responsible for the development of modified Inspection Modules based on input from NRR. The Chief, Human Factors and Safeguards Branch, RES, is responsible for developing and managing the research to meet NRR requirements and for delivering the products in a timely manner consistent with quality and programmatic constraints. The research will be carried out in accordance with the February 3, 1982 established procedures for the NRC research process.

3. Licensing Examination

There are two major goals of this element: (1) to develop valid and reliable licensing examinations for reactor operator (RO), Senior Reactor Operator (SRO), and other licensed personnel to ensure the adequacy of training and the capability of candidates to safely perform their duties; and (2) to develop and implement a standardized examining process that will ensure consistency, reliability and efficiency across examiners, facilities, and regions.

The benefits which result from accomplishing this goal are:

- improved confidence that individuals that are licensed have knowledges, skills and abilities required to perform on the job;

- better focused utility training programs;

- efficient use of licensee and NRC resource requirements to prepare and administer the operator licensing examinations.

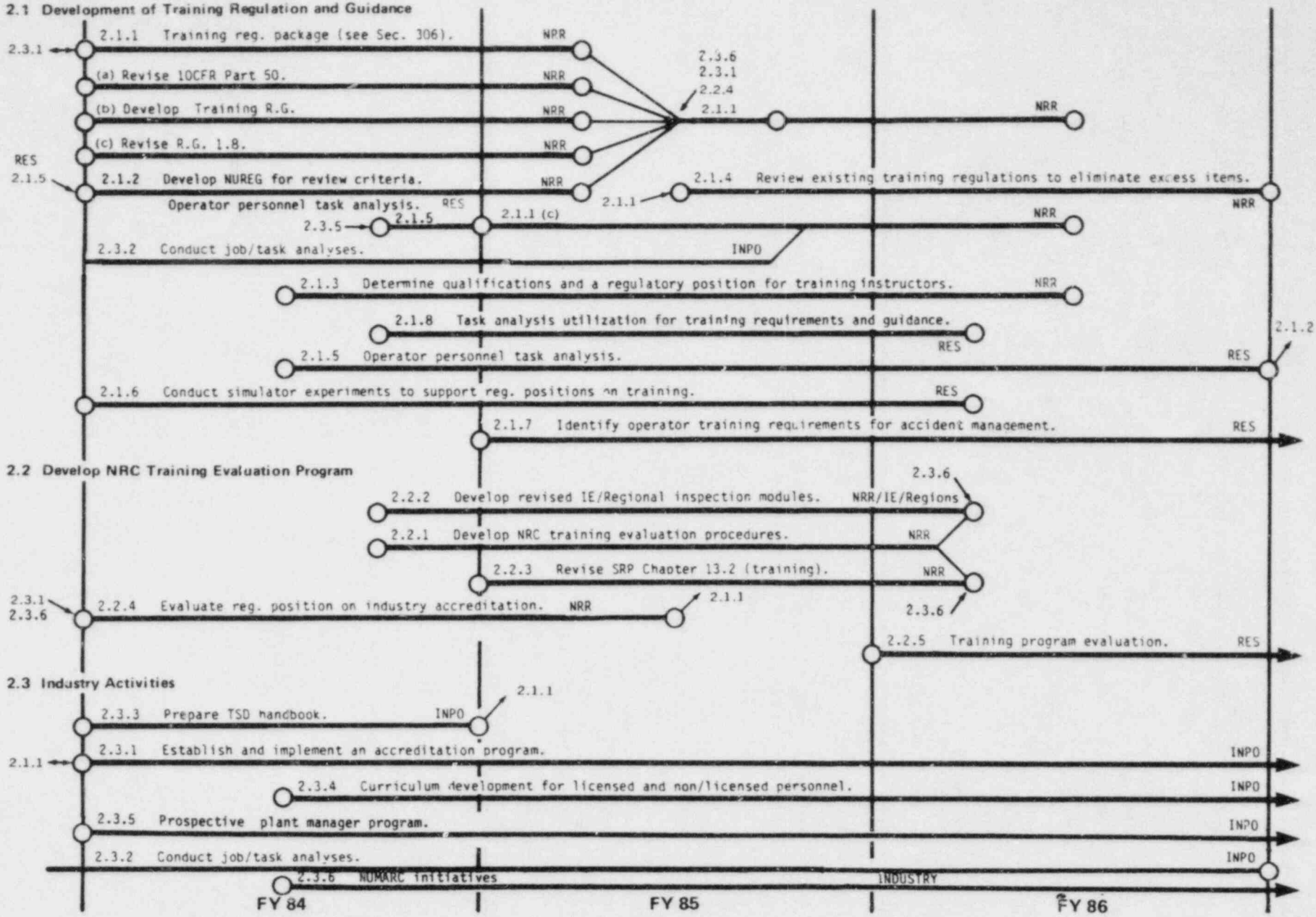

Figure III: 2.0 Training Activity Sequence Diagram

The issues of concern in this element are:

- modifying the examination process without unnecessary impact to current license candidates and training programs;
- the need to ensure that the licensing examination is a valid measure of NPP operators and other licensed personnel ability to perform necessary tasks and functions;
- the need to correlate the licensing examination with improved training programs;
- the need for more consistent examinations and examining practices by NRC examiners.

3.1 The Examination Content

In order to identify the proper content of RO and SRO licensing examinations, the following activities will be performed:

- identify the PWR RO and SRO tasks, duties, and required knowledge, skills and abilities (KSAs) necessary for safe performance using the INPO job/task analysis (JTA), verified by subject matter experts (NRR) (High Priority);
- identify the BWR RO and SRO tasks, duties, and required KSAs necessary for safe performance using the INPO JTA, verified by subject matter experts (NRR) (High Priority);
- develop PWR and BWR test specifications for licensing examinations to provide examiners guidance on the necessary types and levels of knowledge for RO/SRO job performance and the development, administration and grading of tests and test items (NRR) (High Priority);
- update PWR and BWR test specifications to incorporate new KSAs stemming from initial omissions and plant-specific information (NRR) (High Priority);
- develop an improved computerized bank of examination questions for use in test construction and examination validation. The bank will include both a content categorization scheme linked to the job/task analysis and item analysis indices (e.g., item difficulty, discrimination) to provide feedback to examiners on test score results (NRR) (High Priority);
- develop procedures and pilot-test programs/procedures to incorporate item and test level data into the computerized examination question bank to allow for content and statistical analysis of the examination and test items (NRR) (High Priority);
- develop improved test specifications for requalification examinations to incorporate KSAs and plant specific information (NRR) (High Priority);
- develop test specifications for research reactor operators, instructors and fuel handlers based upon an analysis of the associated tasks, duties, and KSAs (NRR) (High Priority).

3.2 The Examination Process

New examination procedures will be evaluated to increase the efficiency, reliability, and validity of the licensing examination process. The following activities will be performed:

- identify optimal format and procedures for each examination component, including written, oral and simulator, to provide a model for the evaluating process (NRR) (High Priority);

- develop and pilot-test procedures for simulator examinations, including a vendor-specific list of plant events/scenarios, an inventory of RO/SRO skills to be assessed, adminstration procedures, and candidate evaluation guidelines (NRR/RES) (High Priority);

- develop and implement programs to (re)train examiners in the areas of examination development, administration and grading (candidate evaluation). These areas are to include use of the examination question bank, job knowledge catalog, essay question writing workshops, and simulator scenario development and administration (NRR) (High Priority);

- develop and validate methods and criteria for evaluating the adequacy of NPP simulators for use in conducting operating examinations. Develop skill qualifications for personnel to be tasked with performing these evaluations (NRR/RES) (High Priority);

- update 10 CFR Part 55 and associated Regulatory Guides to reflect changes made in the examination process and to respond to PL 97-425 (NRR/RES) (High Priority).

3.3 Long-Term Efforts

A long-term effort will be undertaken to apply state-of-the-art advances in testing, measurement, licensing and validation to NPP operator examinations. This long-term effort will include the following:

- develop long-term development and validation strategies based on the results of current examination modifications and content validation (NRR/RES) (Medium Priority);

- evaluate the appropriateness and feasibility of new examination strategies, such as generic written examinations, new exam formats, computer-assisted testing, etc. (NRR/RES) (High Priority);

- evaluate the feasibility of identifying/developing adequate on-the-job performance measures for use in both assessing the ability of the examination to predict operator competence and identifying improvements that should be made in examination content or process (NRR/RES) (High Priority);

- evaluate the use of an FAA "check pilot" type program for the requalification of reactor operators (SECY 84-167) (NRR) (Medium Priority);

- if deemed feasible, conduct a trial check operator program in one region and evaluate results (NRR) (Medium Priority).

3.4 Industry Activities

INPO's control room operator job/task analysis is a major input in the development of content-valid examinations and will provide a basis for attempting to establish operator performance criteria. Plant-specific job/task analyses performed at individual sites will be used to the extent available. Utility training programs will be monitored to ensure consistency between training program curriculum and objectives, and the content and level of knowledge assessed in NRC examinations.

Subject-matter experts from utility operating staffs will also be used in the development of content-valid examinations.

3.5 End Products

The products of this program element include:

- an improved computerized task item bank for examiner use in developing examinations (FY-85) (High Priority);
- test specifications for use as examination blueprints in constructing examinations (FY-85) (High Priority);
- improved examination administration procedures; oral, written and simulator (FY-85) (High Priority);
- statistical analysis and content validation of examinations and test items (FY-87) (High Priority);
- new/revised standardized guidance and training for examiners (FY-85) (High Priority);
- revisions to 10 CFR Part 55 (FY-85) (High Priority);
- revision of Regulatory Guide 1.149, "Nuclear Power Plant Simulators for Use in Operator License Examinations" (FY-85) (High Priority);
- revision of Regulatory Guide 1.134, "Medical Evaluation of Nuclear Facility Personnel Requiring Operator Licenses" (FY-85) (High Priority);
- long-term improvements to examinations and examination processes (FY-87) (Medium Priority).

Figure III-3 depicts the sequence of activities leading to these end products.

3.6 Responsibility

The responsibility for implementation of the activities described in this program element is divided. The Chief, Operator Licensing Branch (OLB), NRR,

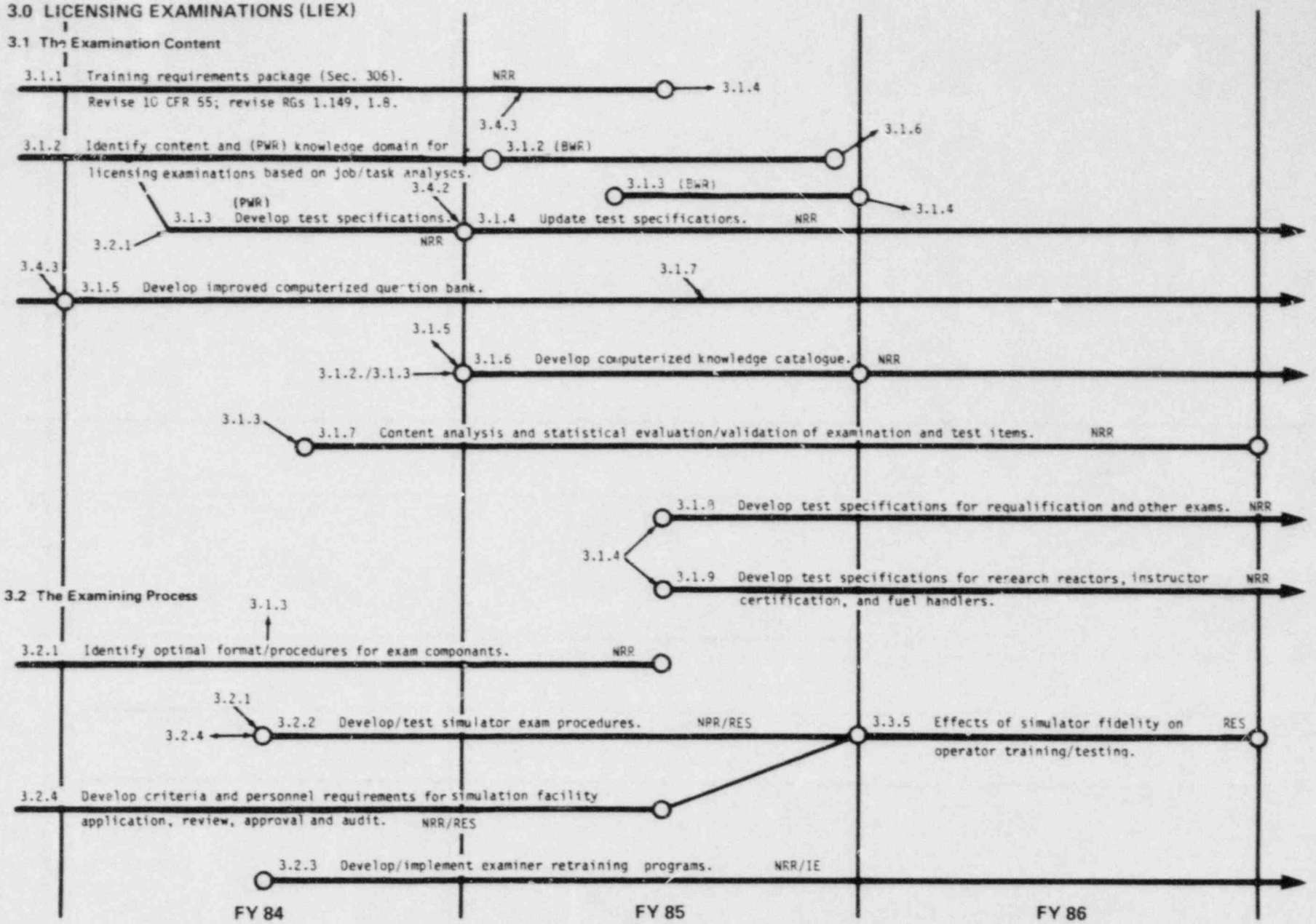

Figure III: 3.0 Licensing Examinations Activity Sequence Diagram

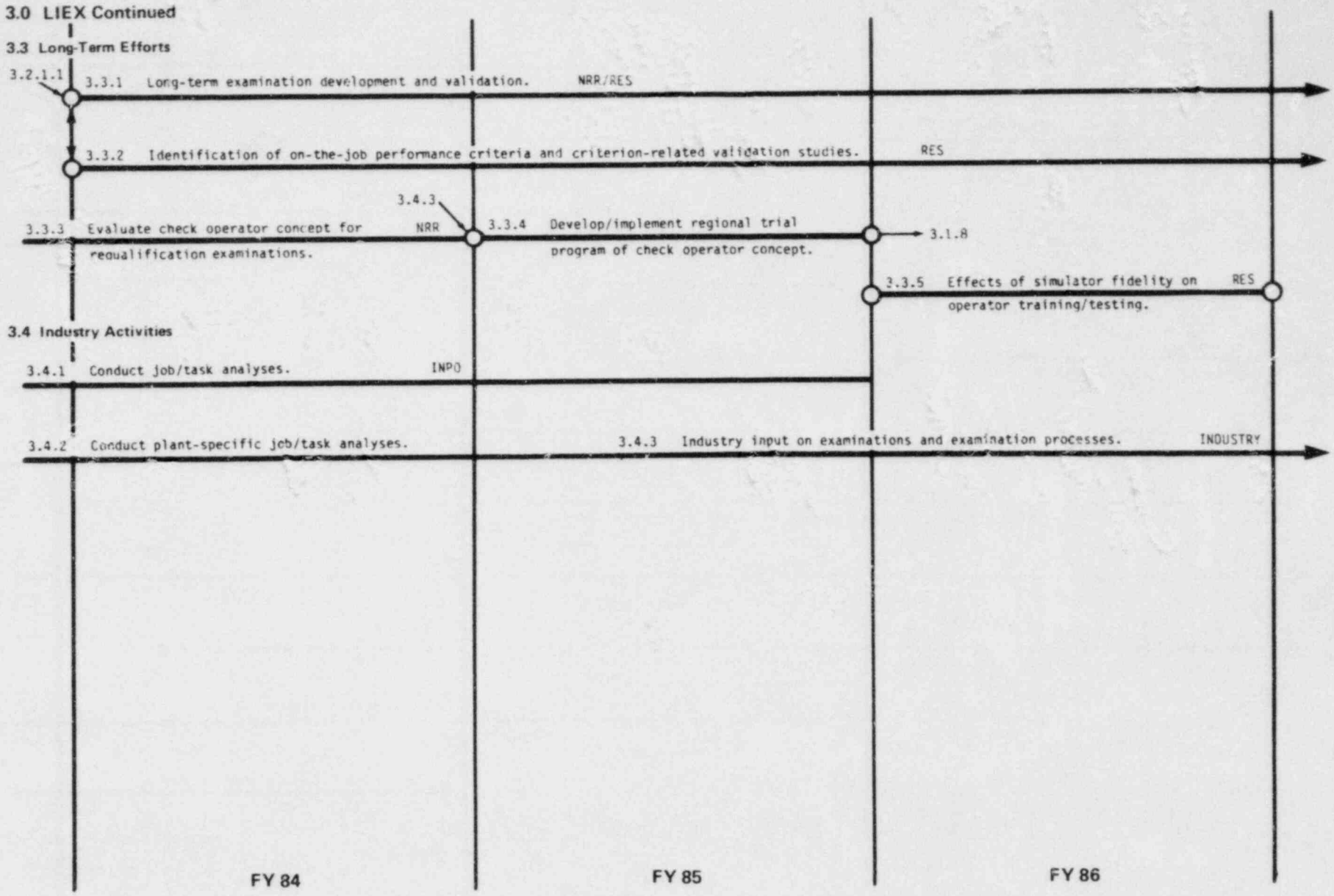

Figure III: 3.0 Licensing Examinations Activity Sequence Diagram

is responsible for assuring regulatory requirements for the near-term improvements in examinations and the examination process, for identifying research and standards needs to assist in implementing the regulatory process of examinations, identifying required dates for products from research and for standards, and managing the NRR technical assistance program. The Chief, Human Factors and Safeguards, RES, is responsible for developing and managing the research to meet NRR requirements and for delivering the products in a timely manner consistent with quality and programmatic constraints. The research will be carried out in accordance with the February 3, 1982 established procedures for the NRC research process.

4. Procedures

The primary goal of this element is to ensure the adequacy and effectiveness of plant procedures. Achievement of this goal will allow operators to maintain plant safety functions under all conditions, including the ability to control upset conditions without first having to diagnose the specific initiating events. This goal will be met by: (1) developing guidelines for preparing, and criteria and methods for evaluating, emergency operating, operating, and other procedures which affect plant safety; and (2) upgrading the procedures, training the operators in their use, and implementing the upgraded procedures. In addition safety/safeguards interactions will be examined to identify procedural deficiencies and potential conflicts between safety and security requirements.

The benefits which result from accomplishing this goal are:

- reduced risk to the public health and safety through use of procedures which increase operator's ability to control upset conditions, including degraded core conditions;

- a framework for evaluating and integrating procedural fixes proposed as the resolution to unresolved safety issues into current procedures without introducing potential error in the procedures.

- establish effective communication procedures between plant management and security management/supervision in order to maintain site security while responding to the plant's safety-related emergency.

- expedite ingress of off-site responding emergency personnel to include timely issuance of radiation protection equipment.

4.1 Procedures Guidance and Criteria

This effort will provide guidance to improve Emergency Operating Procedures (EOPs), abnromal operating procedures (AOPs), operating procedures (OPs), and procedures for emergency plan implementation, refueling, administration, safeguards, and security. It is anticipated that the methods employed in the generation of NUREG-0899, "Guidelines for the Preparation of Emergency Operating Procedures" will be followed in developing guidance for other procedures. If required, industry will develop generic technical guidelines and the NRC and industry will coordinate the development of human factors guidelines. NRR and IE are jointly developing a revised inspection module for use

by the Regions in auditing EOPs utilizing Procedures Generation Packages. Similar inspection modules will be developed for other procedures when guidelines for their upgrading are developed. Safeguards guidance will provide detailed appropriate duties and responsibilities of the safety/safeguards personnel during various postulated events. The guidance criteria will expand upon that found in NUREG/CR 3251, "The Role of Security During Safety-Related Emergencies at Nuclear Power Plants." Specific changes to existing NRC guidance will also be recommended. The following activities are planned:

- revise the inspection module and develop associated training for Regional audit of EOPs (NRR/OIE) (High Priority);
- determine need for and develop regulatory action with respect to OPs and AOPs (NRR) (High Priority);
- determine need for and develop regulatory action with respect to other procedures (NRR) (High Priority);
- develop methods and evaluate alternative techniques and formats for presenting procedures (e.g., computerized CRT presentation) (RES) (High Priority);
- develop methods for evaluation of the in-plant effectiveness and impact of upgraded EOPs (RES) (Medium Priority);
- evaluate the in-plant effectiveness and impact of upgraded EOPs (NRR/RES) (Medium Priority);
- develop methods and evaluate the use of procedures under stress/severe accidents (NRR/RES) (High Priority);
- determine impacts of computer diagnostics and automation on procedures and regulatory requirements (RES) (Medium Priority);
- determine applications of artificial intelligence concepts to procedure prompting (RES) (Medium Priority);
- develop guidance and regulatory action with respect to the use of computer diagnostics and artificial intelligence to support procedures (NRR) (Medium Priority);
- determine the impact of severe accident research on technical guidelines and development of procedures which address severe accidents (RES/NRR) (High Priority);
- determine the extent of interaction between safety/safeguards personnel in the event of a safety-related emergency (SRE) (RES) (Medium Priority);
- determine human factors problems which could adversely impact safety/safeguards interactions, such as: breakdown in vigilance, inadequate training, alternative communication modes, etc. (RES) (Low Priority);

- determine if existing methods and procedures at power reactors involving interactions between safety, safeguards and off-site emergency personnel need revision (RES/NMSS) (High Priority);

- evaluate existing NRC guidance on safety/safeguards interactions during SREs (RES/NMSS) (High Priority);

- develop guidance detailing the appropriate duties and responsibilities of safety/safeguards personnel during SREs (RES/NMSS) (High Priority).

4.2 Industry Activities

Owners' Groups, supported by the vendors, have developed generic EOP technical guidelines. INPO and industry have prepared a detailed writer's guide for licensees and applicants to use when preparing EOPs. EPRI has worked to ensure that effort regarding the safety parameter display system (SPDS) are fully integrated with the function-based EOPs.

4.3 End Products

The products of this effort will be:

- the development of revised inspection modules for use by the Regional Offices for evaluating EOPs (FY-84) and AOPs, OPs, MPs, and other procedures, as necessary (FY-87) (High Priority);

- the development of guidance similar to NUREG-0899 to be used by the industry to prepare upgraded AOPs, OPs, and other procedures (FY-86) (High Priority);

- methodology for the evaluation of alternative techniques and formats for presenting procedures (FY-85) (High Priority);

- conduct an evaluation of the in-plant effectiveness and impact of upgraded EOPs (FY-86) (Medium Priority);

- methodology for the evaluation of the use of procedures under stress/ severe accidents (FY-87) (High Priority);

- development of guidance detailing appropriate duties and responsibilities of safety/safeguards personnel during SREs (FY-84) (High Priority);

- methodology for identification of optimum methods for handling variation in vigilance, access control checkpoints, communications, training, command/control techniques, etc. (FY-84) (High Priority);

- development of procedures for off-site responding emergency personnel and issuance of radiation protection equipment (FY-84) (High Priority).

Figure III-4 describes the sequence of activities leading to these end products.

4.0 PROCEDURES (PROC)

4.1 Development of Procedure Guidance and Criteria

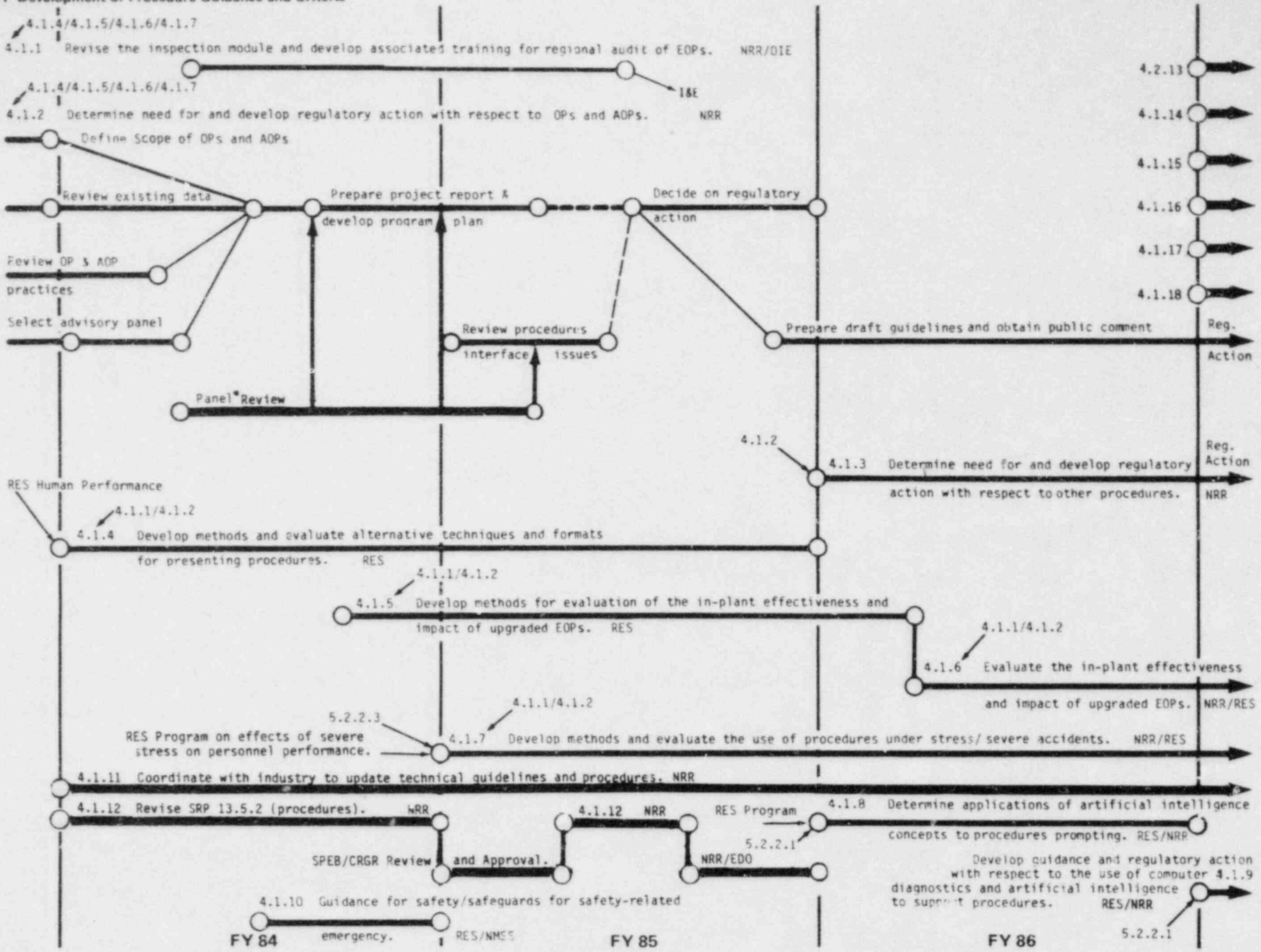

Figure III: 4.0 Procedures Activity Sequence Diagram

4.4 Responsibility

The responsibility for implementation of the activities described in this program element is divided. The Chief, Procedures and Systems Review Branch (PSRB), NRR, is responsible for the conduct of all NRR activities listed in Sections 4.1 and 4.2, identifying research and standards needs to assist in implementing the regulatory process, identifying required dates for products from research and for standards, and managing the NRR technical assistance program. The Chief, Human Factors and Safeguards Branch (HFSB), RES, is responsible for developing and managing the research to meet NRR and NMSS requirements and for delivering the products in a timely manner consistent with quality and programmatic constraints. The research will be carried out in accordance with the February 3, 1982 established procedures for the NRC research process.

5. Man-Machine Interface (MMI)

The goal of this element is to ensure the adequacy of the MMI in all aspects of NPP operation and maintenance relative to the safe performance of the man-machine system. This goal will be met by developing (1) human factors engineering guidelines and technical bases for correcting MMI problems; and (2) regulatory guidance to assure that human factors engineering is appropriately integrated into new designs and incorporated into advanced technological improvements to existing designs; and (3) detailed critical man-machine interface considerations for central alarm station/secondary alarm station (CAS/SAS) design and safeguards equipment.

The benefits which will result from accomplishing this goal are:

- significant reduction in human errors through improvements in control rooms and plant design;
- efficient and effective job performance by operational personnel through improvements in control room design and at other manned stations;
- enhanced (cost-efficient) operational performance and/or improved allocation of functions to man and machine.
- improved design of intrusion alarm systems, safeguards equipment training programs and modes of using contingency plans.

The issues in this element are:

- extent to which regulatory positions should be developed for MMI issues beyond the control room;
- characteristics of regulatory guidance on the use of advanced technologies for safety and safeguards equipment.

A significant concern within this element is the issue of backfitting. Other MMI issues identified in this program are directed at providing evaluation tools for (1) the next generation of plants, and (2) changes expected to be proposed by licensees such as upgraded systems for managing information and

data and improved annunciator systems. Also, these efforts will significantly improve the capability of the staff to evaluate reactor incidents involving MMI errors and provide capability to evaluate advanced designs for the next generation of plants.

5.1 MMI Guidance for Existing Designs

To date, regulatory attention has been primarily limited to those interfaces that exist in the control room and at the remote shutdown panel. Further guidance is needed regarding: (1) local control stations and auxiliary operator interfaces; (2) improvements to annunciator systems; (3) emergency response facilities and preparedness; and (4) security/safeguards personnel and security/safeguards systems and equipment.

Local Control Stations and Auxiliary Operator Interfaces

Information is required to enable the NRC to determine if additional guidance on local control station design and auxiliary operator interfaces with these stations should be developed. NUREG/CR-3696, "Potential Human Factors Deficiencies in the Design of Local Control Stations and Operator Interfaces" concluded that NUREG-0700 was applicable to current designs with the exception of (1) design of manually-operated valves, and (2) extreme environmental conditions. For new designs information will be developed by the following activities:

- conduct job/task analyses of control room crew activities to identify and describe communications and control links between the control room and auxiliary control stations (RES) (Medium Priority);

- analyze auxiliary personnel functions based on control room crew task analyses to estimate the potential impact of errors to plant safety (RES) (Low Priority).

Improvements to Annunciator Systems

NUREG-0700, "Guidelines for Control Room Design Reviews," provides a "standard of quality" for annunciator systems which, if incorporated, should minimize the potential for human error associated with these systems. Advanced technologies are expected to be utilized in the development of improved NPP annunciator systems. Guidelines for annunciator improvements will be developed based on an evaluation of results from EPRI, RES. Halden, and other advanced concept activities at Seabrook and Savannah River.

- develop and demonstrate an operational aid system based on a combination of generalized annunciator alarm prioritization and procedures (RES) (High Priority);

- develop guidelines for long-term annunciator improvements which address advanced techniques for implementing the quality standards of NUREG-0700 (RES) (Medium Priority).

- develop a Regulatory Guide for annunciator system designs (RES) (Medium Priority).

Improvements to Safeguards Systems

Guidance is needed for the development of regulatory requirements concerning the interface of safeguards personnel with automated systems and safeguards equipment at use in nuclear power plants. This guidance will be developed through the following activities:

- investigate the interactions between safeguards personnel and nuclear power plant systems to assess and identify man-machine interfaces, (RES) (Medium Priority);

- identify needed improvements which would enhance safeguards and/or safety; (RES) (Medium Priority)

- develop an overall regulatory position on the MMI in safeguards along with a technical basis for regulatory action (RES) (Medium Priority).

5.2 MMI Guidance for Designs Based on Advanced Technologies

Existing human engineering guidelines for NPP control rooms primarily address control, display, and information concepts and technologies which are now being used in process control systems. While these guidelines are adequate for assessing and upgrading the MMIs in the current generation of NPPs, they may not be sufficient for assessing advanced and developing technologies that may be introduced into existing and future generation designs. This concern will be addressed through investigation in the areas listed below.

Computers

Presently, no NRC guidance is available concerning the management of data and information in the NPP control room during abnormal events, transients, and accidents. During FY-84 and FY-85, a plan will be developed to evaluate important safety problems. Products of the program will include guidance on control room information management during severe transients and accidents, and Regulatory Guides on information management. The guidelines will be directed at data management methods which minimize human error. (RES) (High Priority)

Advanced Controls and Displays

Presently 10 C.F.R Part 50.34(f), "Additional TMI-Related Requirements," requires each applicant for a light-water-reactor construction permit or manufacturing license to provide, for NRC review, a control room design that reflects state-of-the-art human factor principles.

To provide staff guidance pertinent to the interface between new control and display techniques and the human operator, during FY84-FY86 the following activities are planned:

- develop evaluation methods and design criteria for visual displays to be used as a Regulatory Guide (RES) (High Priority);

- establish criteria needed for regulatory assessment of advanced control room concepts (RES) (High Priority);

- track and evaluate new and developing technologies that have potential for application in NPP control rooms such as artificial intelligence applications (RES) (Medium Priority);

- identify control and display requirements for crew response needs subsequent to seismic events (RES) (Low Priority).

Function Allocation

An integrated program plan for investigating function allocation will be developed to determine:

- the NPP functions involving a human component (RES) (Low Priority);

- whether current function allocations (especially in control rooms) permit reliable performance of functions assigned to humans (RES) (Low Priority);

- identify design changes which enhance function performance (RES) (Low Priority);

- the need to reallocate functions between the human and machine components of the NPP system (RES) (Low Priority);

- which functions should be reallocated (RES) (Low Priority);

- the feasibility/desirability of applying cognitive workload measurement techniques to a selected list of operator functions (RES) (Low Priority).

The implementation of this program will provide data necessary for establishing a regulatory position on function allocation and the appropriate roles of the human components.

Safety Status Indication

Based on a project that investigated currently available technology for monitoring and verifying operations, tests, and maintenance activities, the staff has determined that the following actions are necessary:

- the development of long-term improvement guidance for improvement of safety system status monitors (NRR/RES) (Medium Priority)

- revision to Regulatory Guide 1.47 (RES) (High Priority)

5.3 Regulatory Documents in Support of the Man-Machine Interface

Regulatory activities in support of the man-machine interface are planned as follows:

- development of Human Factors General Design Criteria (RES) (Medium Priority);

- develop and maintain revisions to Chapter 18, "Human Factors Engineering" to the Standard Review Plan (NRR) (Low Priority).

- recommendations for a regulatory position and related training requirements for safeguards concerns (RES) (High Priority)

5.4 Industry Activities

The nuclear industry has several efforts devoted to MMI issues. EPRI's work on backfitting annunciator improvements, control room enhancement, and display research for the safety parameter display system are all contributing significantly to the resolution of human factors concerns in the control room. The HALDEN Project has been asked to conduct research for the NRC in control room enhancement, advanced display concepts, and alarm handling methods.

5.5 End Products

The products of this elements include:

- a proposed regulatory position addressing local control stations and auxiliary operator interfaces (FY-84) (NRR) (Medium Priority);

- a technical report and regulatory guidelines addressing long-term advanced annunciator system designs (FY-87) (High Priority);

- a technical report on control room information management during severe transients and accidents (FY-87) (Medium Priority);

- Evaluation Criteria for the use of computers for data and information management in control rooms (FY-87) (Medium Priority);

- a Regulatory Guide on information management methods (FY-87) (Low Priority);

- a report on the means for investigating function allocation (FY-87) (Low Priority);

- a revision to Regulatory Guide 1.47 (FY-86) (High Priority);

- Human Factors General Design Criteria (FY-85) (Medium Priority);

- revision to Chapter 18, Standard Review Plan (FY-87) (Low Priority).

- Identification of MMI issues in safeguards by reviewing current technology (FY-86) (Medium Priority);

- recommendations for a regulatory position for safeguards (FY-87) (Medium Priority).

Figure III-5 describes the sequences of activities leading to these end products.

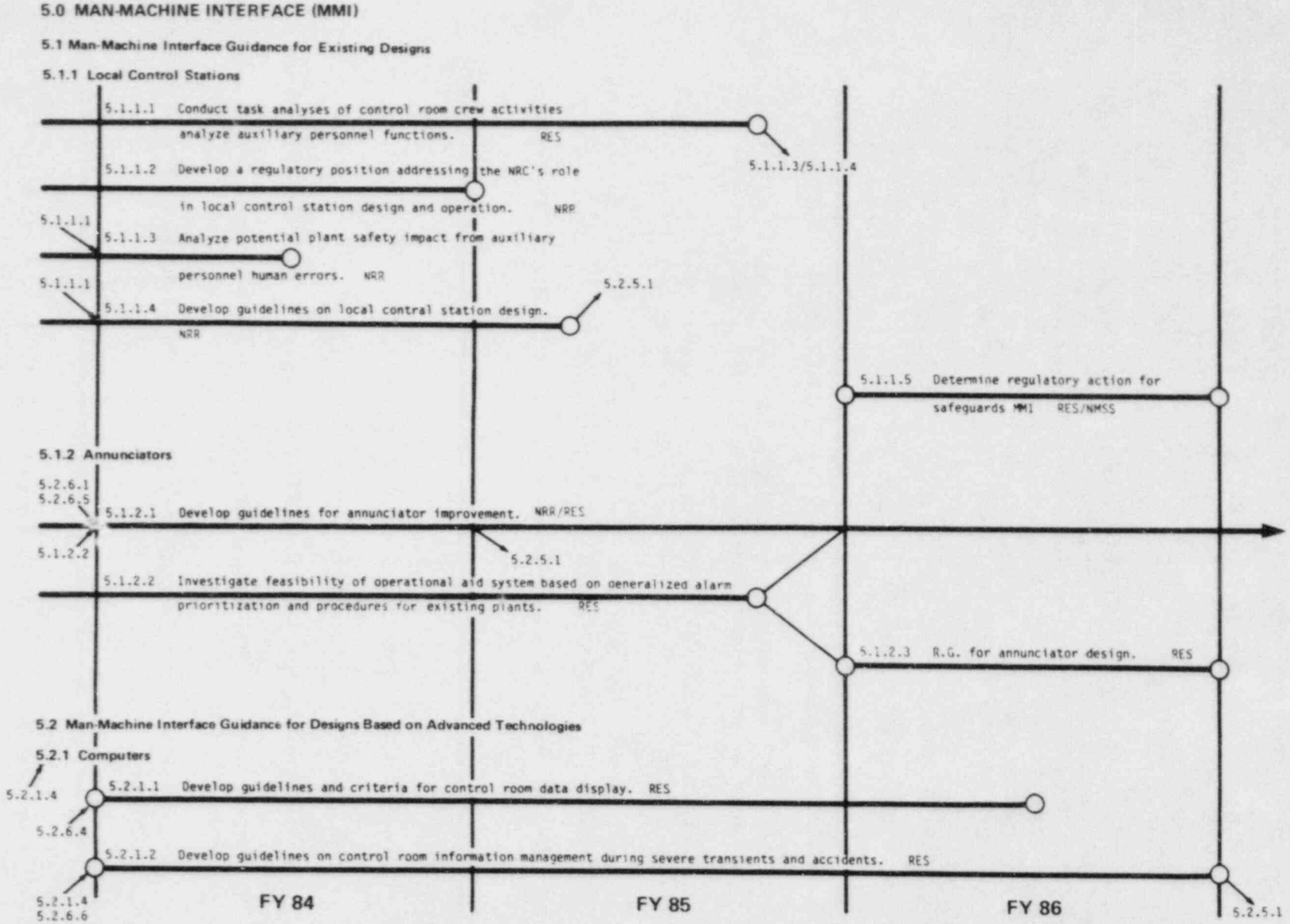

Figure II: 5.0 Man-Machine Interface Activity Sequence Diagram

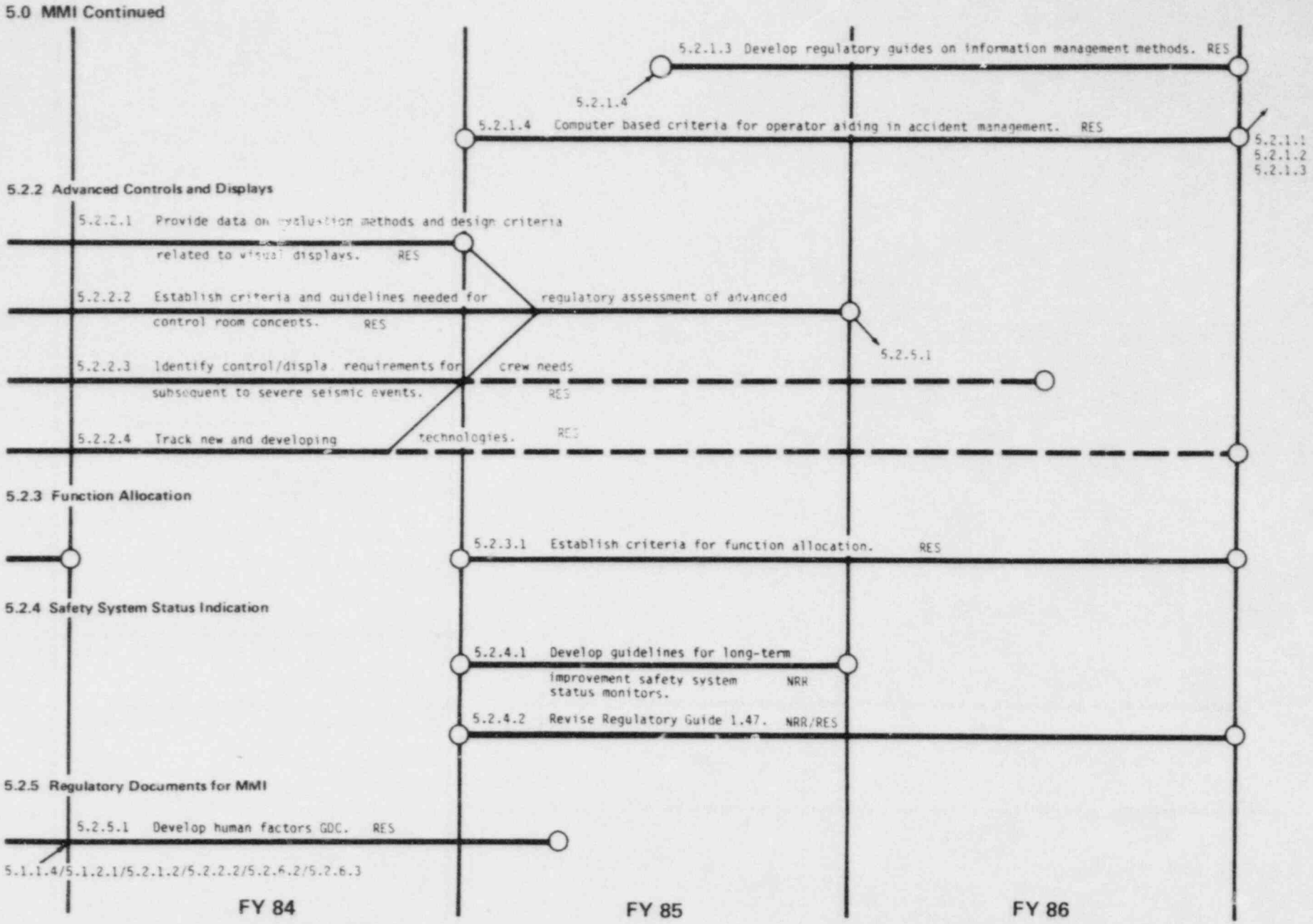

Figure III: 5.0 Man-Machine Interface Activity Sequence Diagram

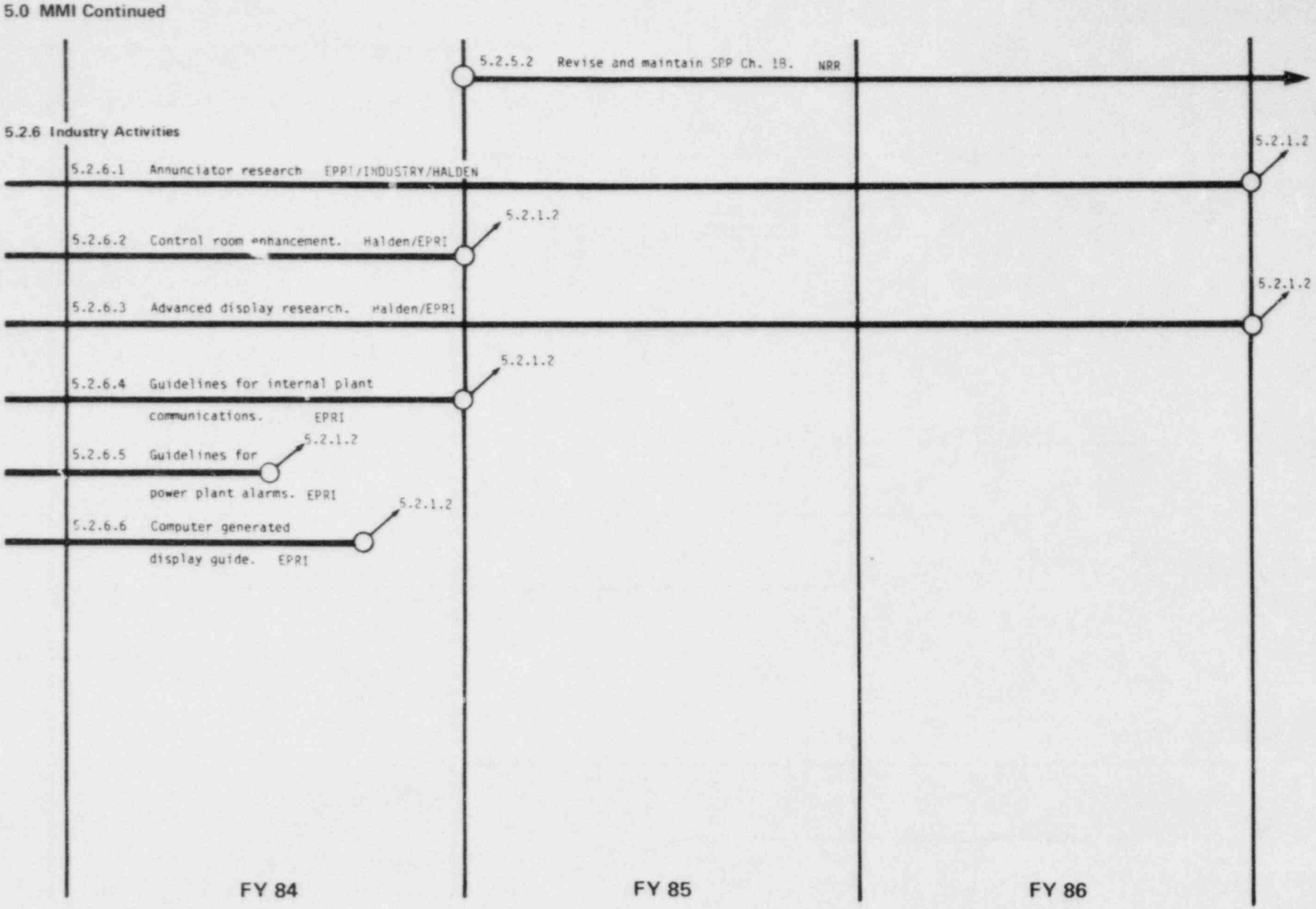

Figure II: 5.0 Man-Machine Interface Activity Sequence Diagram

5.6 Responsibility

The responsibility for implementation of the activities described in this program element is divided. The Chief, Human Factors Engineering Branch (HFEB), NRR, is responsible for the conduct of all NRR activities listed in Sections 5.1 and 5.2, identifying research and standards needs to assist in implementing the regulatory process, identifying required dates for products from research and for standards, and managing the NRR technical assistance program. The Chief, Human Factors and Safeguards Branch, RES, is responsible for developing and managing the research to meet NRR requirements and for delivering the products in a timely manner consistent with quality and programmatic constraints. The research will be carried out in accordance with the February 3, 1982 established procedures for the NRC research process.

6. Management and Organization

The goal of this element is to develop and test approaches and techniques for assessing nuclear utility management and organization capabilities to safely control both routine and abnormal events associated with nuclear power plant (NPP) construction, operation and maintenance. This goal will be met by accomplishing the following objectives: (1) develop approaches and techniques to determine the relationships between utility management and organization factors and plant safety; (2) develop and test reliable, objective evaluation procedures for assessing the adequacy of organization and management functions such as control and coordination of operations, maintenance, security and safety review committees, and characteristics such as internal/external plant communication and administrative controls; and (3) provide the technical basis for an NRC regulatory position on management and organization at operating nuclear power plants.

The benefits that will result from accomplishing these objectives are:

- reduction of the number and severity of management and organization issues that could lead to unsafe NPP conditions;

- nuclear power utility management and organization which is responsive to and has the resources to resolve safety related issues, and allocates resources and responsibilities to ensure public health and safety during NPP construction, operation and maintenance.

The issues of concern in this element are:

- lack of quantitative and qualitative information concerning appropriate utility management and organization functions and roles which directly or indirectly impact safety, for making objective determinations of adequate NPP management and organization, and establishing guidelines for evaluating those functions and roles;

- lack of reliable, objective performance evaluation procedures for use by NRC staff in assessing the adequacy of operating license (OL) applicants' organization and administration plans (OAPs), and operating reactor (OR) policies, procedures and operating experience in maintaining the public health and safety.

6.1 Regulatory Position on Management and Organization at Operating Reactors

An evaluation of INPO's review criteria for corporate and plant assistance visits will be completed by NRR in FY 1984. The NRR staff will use the information, in addition to the assessment of other on-going evaluation activities of ORs (PAT, SALP, ANI, etc.) to determine if a modification of exisitng regulations is warranted. A Staff paper will be completed by the end of FY 1984 and will provide a recommendation on the regulatory position that the NRC should adopt on the management and organization issue at ORs. If that staff paper contains a recommendation to change the existing regulatory position on management and organization at operating nuclear power plants, NRR will begin the necessary work to develop the new regulation in FY 1985. During FY 85-86, to support the licensing, and inspection and enforcement activities, RES will complete function and role analyses, and modeling studies, to identify safety-related factors (e.g., configurations, communications networks, policies, practices) that are characteristic of well organized and managed utilities with ORs. Additionally, RES will complete refinement and validation of objective organization and management safety performance indicators (e.g., regulatory compliance, licensing reviews, inspection and enforcement reviews, insurance risk assessments) for utilities with ORs. This latter work was begun by RES during FY 82 and continued by NRR as part of its Safety Technology Program during FY 83-84. To accomplish the above objectives the following NRR and RES activities will be performed:

- monitor INPO's evaluations of nuclear power plants and utility corporate offices (NRR) (Medium Priority);
- evaluate INPO and other review criteria (NRR) (Medium Priority);
- evaluate the need for a regulatory position on management and organization (NRR) (High Priority);
- develop a staff paper considering the INPO evaluation criteria for management and organization (NRR) (Medium Priority);
- develop a staff paper to recommend an NRC position on management and organization at ORs (NRR) (Low Priority);
- develop and evaluated a quantifiable method of evaluating safety significant NPP management and organization factors at ORs, using safety performance indicators (NRR) (Medium Priority);
- develop technical data base of organization and management functions and roles, and identify safety-related factors that are characteristic of well run utilities with ORs (RES) (Medium Priority).
- refine and validate objective organization and management safety-related performance indicators for utilities with ORs (RES) (Medium Priority).

6.2 NRC Management and Organization Guidelines and Assessment Procedures for Operating License Reviews

Guidelines and assessment procedures will be developed by NRR to increase the reliability and consistency of management and organization reviews of operating license applicants.

During FY 85-86, to support these licensing activities, RES will complete function and role analyses, and modeling studies, to identify safety-related factors (e.g., configuations, communications networks, policies, practices) that are characteristic of well organized and managed utilities with OLs. Additionally, RES will complete refinement and validation of objective organization and managment safety performance indicators (e.g., regulatory compliance, licensing reviews, inspection and enforcement reviews, insurance risk assessments) for utilities with OLs.

In order to develop these guidelines, and assessment procedures to be used by the NRC in judging the adequacy of utility management and organization, the following activities will be performed:

- prepare management and organization guidelines for use by OLs (NRR) (Medium Priority);
- develop criteria and procedures for NRC reviewers (NRR) (High Priority);
- prepare a workbook for NRC use during site visits and in preparing a Safety Evaluation Report (SER) (NRR) (High Priority);
- evaluate ISEG and Safety Review Systems (NRR) (Medium Priority);
- revise the Standard Review Plan, Chapters 13.1 and 13.4 (NRR) (Medium Priority);
- review management and organization inspection modules for use by Regional Offices to determine if any revisions are necessary (NRR/OIE) (Medium Priority);
- prepare a training plan and train technical reviewers (NRR/OIE) (High Priority);
- develop technical data base of organization and management functions and roles, and identify safety-related factors that are characteristic of well run utilities with OLs (RES) (Medium Priority).
- develop, refine and validate objective organization and management safety-related performance indicators for utilities with OLs (RES) (Medium Priority).

In order to develop these assessment procedures and the review documents to be used by the NRC in judging the adequacy of utility management and organization, the following activities will be performed:

- prepare management and organization guidelines for use by applicants for operating licenses (NRR) (Medium Priority);

- develop criteria and procedures for NRC reviewers (NRR) (High Priority);

- prepare a workbook for NRC use during site visits and in preparing an SER (NRR) (High Priority);

In addition, technical reviewers will be trained to improve interview capabilities. This will involve training workshops on the use of the revised SRP and the new reviewer workbook for use while conducting site reviews.

6.3 Industry Activities

As approved by the Commission, the number of PAT inspections has been reduced in recognition of similar plant evaluations conducted by INPO. NRC review of INPO effectiveness in this program has been arranged through an NRC-INPO coordination plan. INPO also has a program to evaluate utility management for plants under construction. This is accomplished by self-initiated evaluations by the utilities using criteria supplied by INPO, and INPO also conducts on-site evaluations. INPO has also started a program of workshops for utility managers to assure that they are committed to quality work in conformance with applicable guides and regulations.

6.4 End Products

The products of this program element will include:

- MOU with INPO concerning Corporate Evaluation Activity (FY-84) (Medium Priority);

- a regulatory position on Management and Organization (FY-86) (High Priority);

- NRC reviewer procedures (FY-84) (Medium Priority);

- revised Chapters 13.1 and 13.4, Standard Review Plan (FY-85) (Medium Priority);

- evaluation of Independent Safety Evaluation Group (ISEG) and safety review systems (FY-84) (Medium Priority).

Figure III-6 depicts the sequence of activities leading to these end products.

6.5 Responsibility

The responsibility for implementation of the activities described in this program element is assigned to the Chief, LQB, NRR. These responsibilities include the conduct of all NRR activities listed in Sections 6.1 and 6.2, identifying research and standards needs to assist in implementing the regulatory process, and managing the NRR technical assistance program. The Chief, Human Factors and Safeguards Branch, RES, is responsible for developing and managing the research to meet NRR requirements and for delivering the products

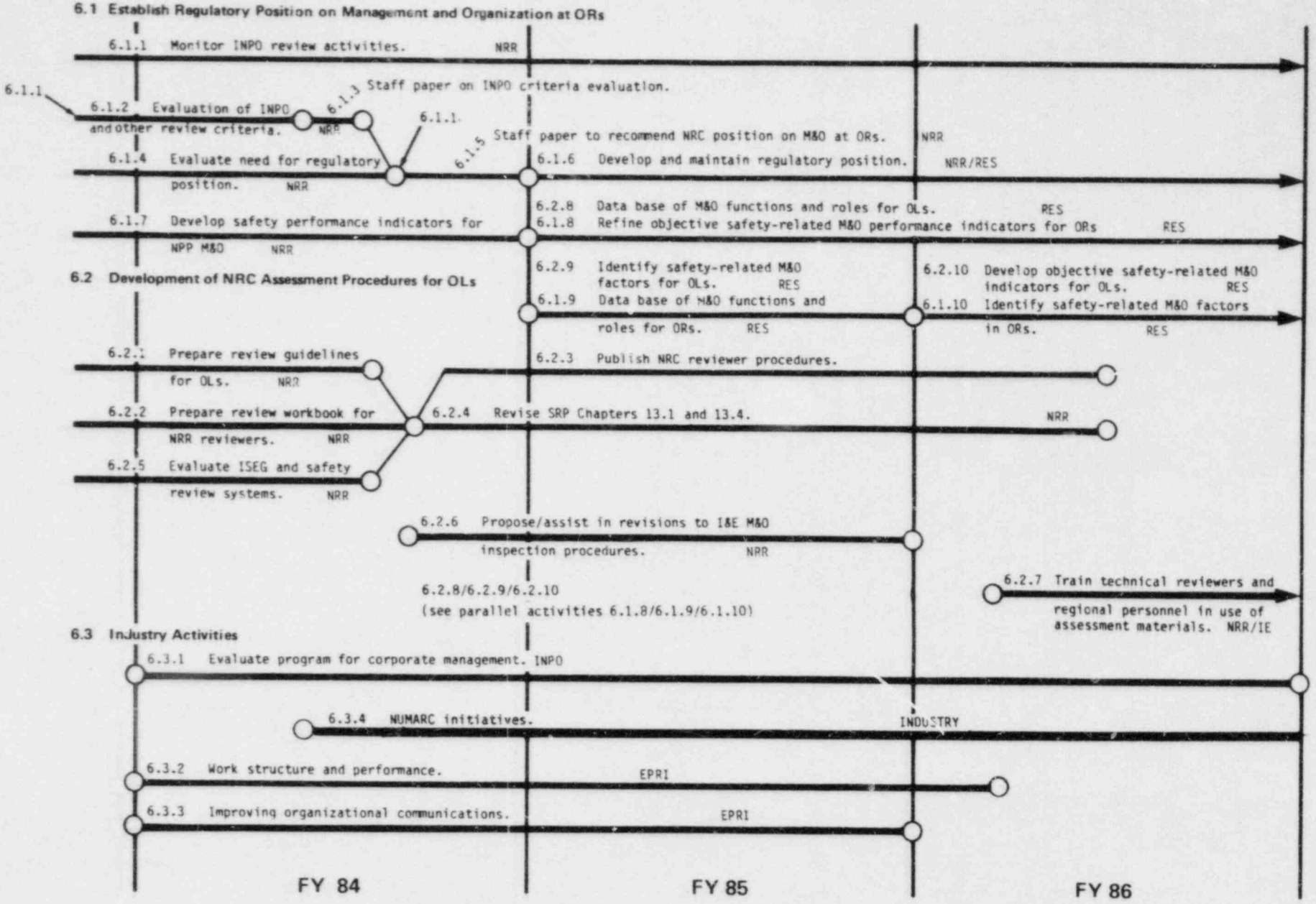

Figure III: 6.0 Management and Organization Activity Sequence Diagrams

in a timely manner consistent with quality and programmatic constraints. The research will be carried out in accordance with the February 3, 1982 established procedures for the NRC research process.

7. Human Reliability

This element has three primary goals. The first goal is to develop a technical support system for NRC reliability evaluations, especially those employing probabilistic risk assessment (PRA) techniques. The second goal is to develop techniques for systematically using quantitative and qualitative human performance data from PRAs, to identify plant man-man and man-machine safety system retrofit requirements, establish baseline measures for evaluating the effects of those retrofits, and to identify future human reliability research requirements. The third goal is to provide feedback links from operating experience (e.g., LERs, PRA results) to other elements of the human factors program.

Goals will be met through (1) obtaining reliable human performance data, (2) develop methodologies to incorporate the effects of human error into PRAs, and (3) using information on the quantitative and qualitative implications of human error for nuclear power station safety systems performance. The benefits which will result from accomplishing these short-term goals are:

- methods and techniques for acquiring reliable human error data from selected field, computer modeling, and expert judgment sources;
- human reliability data bank concept (e.g., computerized data system) for compiling, storing, updating and retrieving human error probability data for use in NRC reliability evaluation programs, especially PRAs;
- analytic tools (e.g., event sequence models) for use by reliability evaluation specialists to conduct human risk analysis (HRA) segments of PRAs;
- techniques for systematically using PRA results to identify plant retrofit requirements, establish objective baseline measures to evaluate plant retrofits and identify future human reliability/human factors research needs.

The issues of immediate concern in this element are:

- lack of reliable human error data available from nuclear power station related events to support NRC reliability evaluation programs such as PRA;
- lack of objective techniques for analyzing human errors involved in safety-related events, especially those involving redundant or interdependent actions of individuals or groups;
- lack of techniques for systematically using PRA results to identify plant retrofit requirements, establish objective baseline measures for evaluating plant retrofits and to identify future human reliability/human factors research needs;

- lack of timely and consistent use of human factors data from LERs in human factors activities, thus limiting the value of lessons-learned feedback.

7.1 Human Error Data Acquisition

To date, nuclear power station PRAs, especially segments involving human risk, are computed using human error probabilities derived from non-nuclear settings (e.g., military weapon systems), coupled with expert judgment. Methods and techniques are therefore needed for collecting reliable human error data representative of operations, maintenance and technical support tasks performed at NPPs. In addition, more effort should be applied to use the human factors data from LERs to feedback information from operating NPPS. These data would be used in event reviews not limited to PRAs.

Research activities ongoing and planned during FY-84 through FY-86 are designed to provide NRC reliability evaluation programs with practical, acceptable and effective methods and techniques for acquiring reliable human error data from a variety of nuclear power related sources.

Significant research involves developing guidelines for acquiring human error data:

- from expert judgment (psychological scaling) employing a variety of procedures (e.g., multi-attribute analysis), involving both control room and non-control room tasks;

- from operating power stations using existing Licensee Event Report (LER);

- from operating power stations using a voluntary anonymous, non-punitive, third party managed reporting concept known as the Nuclear Power Safety Reporting System (NPSRS);

- from computer modeling of power station normal, transient and emergency events.

7.2 Human Error Data Storage and Retrieval

Human error data used to support the PRA process is usually required in the form of human error probability statements (errors commited divided by the number of error chances). Methods and procedures combining raw human error data sets into probability statements, storing them, and making them available to the reliability evaluation specialist in an orderly manner are needed to support the PRA process.

Activities ongoing and planned for FY-84 through FY-86 are designed to provide the NRC with a practical, effective human reliability data bank for use in processing human error data for use by reliability evaluation specialists. Planned activities include testing the utility of a data bank concept for:

- computing human error probability statements from diverse information sources as operating power stations, training simulators, expert judgment and computer simulations;

- storing, updating and retrieving human error probability statements and related information on the basis of equipment characteristics (e.g., vendor, vintage) and human characteristics (e.g., diagnose, monitor, operate, test) for use in the PRA process.

In addition, efficient and timely use of human error data contained in LERs requires that this data be encoded and entered in a data-base management system that can be used in conjunction with statistical software programs. Planned activities include:

- developing a plan and schedule for implementing the human reliability data bank alone or as a part of other NRC data acquisition systems;
- LER coding for human factors error data;
- developing software to select and display cross-classified categorical data.

7.3 Reliability Evaluation Specialist Aids

A comprehensive and accurate analysis of human behavior sequences leading to recognition, diagnosis and reaction to nuclear power station normal, transient and emergency events is necessary for risk assessment. Analytic techniques and methods for portraying adequately the human segments of those events are needed, especially events involving redundant or interdependent actions by individuals or groups. Also needed are techniques for analyzing cognitive and performance shaping factor (e.g., stress, fatigue, attitude) aspects of human behavior. Significant research activities in this area involve:

- developing models (e.g., multiple sequence) for analyzing safety-related events, especially those involving redundancy and/or interdependent actions;
- developing models for objectively analyzing cognitive and performance shaping factor aspects of human behavior within the context of NRC reliability evaluation programs, especially PRAs;
- identifying and categorizing human errors of omission and commission, and performance shaping factors currently included in human risk analysis (HRA) segments of PRAs;
- developing approaches and procedures for integrating HRA into the PRA process, to more adequately assess the impact of human performance on overal plant risk.

7.4 Safety Event Analysis Results Application

The PRAs are a potential source of quantitative and qualitative human performance data, both generic and plant specific. During FY-84-86, human reliability research will be directed toward developing and testing approaches and techniques for systematically using human performance data from PRAs to:

- identify generic and plant specific man-man and man-machine safety system retrofit requirements;

- establish objective baseline performance measures for evaluating plant retrofits;

- identify future human reliability/human factors research needs.

7.5 Industry Activities

The nuclear industry (INPO) is currently conducting a study of the feasibility of a voluntary, non-anonymous Human Performance Evaluation System (HPES). The INPO activity focuses primarily on individual plant data which serves as a basis for plant retrofit. This data will be considered as another potential source of human performance data to support reliability evaluation programs such as PRA.

7.6 End Products

FY-84 through FY-86 products of this element include:

- Human Error Data Acquisition:

  - procedures for estimating human error probabilities in nuclear power station operations using expert judgment (e.g., multi-attribute analysis) (FY-85);

  - procedures for computing human error probabilities from LER data on power station instrumentation and electrical control functions (FY-84);

  - NPSRS for collecting human error data using a voluntary, anonymous, non-punitive, third-party managed approach (FY-84);

  - computer model for predicting human error probabilities on nuclear power station operations and maintenance tasks (FY-84 through FY-86).

- human reliability data bank for compiling, storing, updating and retrieving human error probability statements using an equipment characterization/human behavior characterization matrix approach (FY-84 and FY-85);

- reliability evaluation specialist aids including:

  - procedure for analyzing redundant and interdependent aspects of safety-related events using multiple sequence failure approaches (FY-85);

  - techniques and models for analyzing cognitive and performance shaping factor (e.g., stress, fatigue, attitude) aspects of human behavior within the context of the PRA process (FY-86);

  - approaches and procedures for integrating HRA into the PRA process, to more adequately assess the impact of human performance on overall plant risk (FY-85).

- techniques for systematically using PRA results to identify plant retrofit requirements, establish objective baseline measures to evaluate those retrofits and identify future human reliability/human factors research needs (FY-87).

Figure III-7 depicts the sequence of activities leading to the above products.

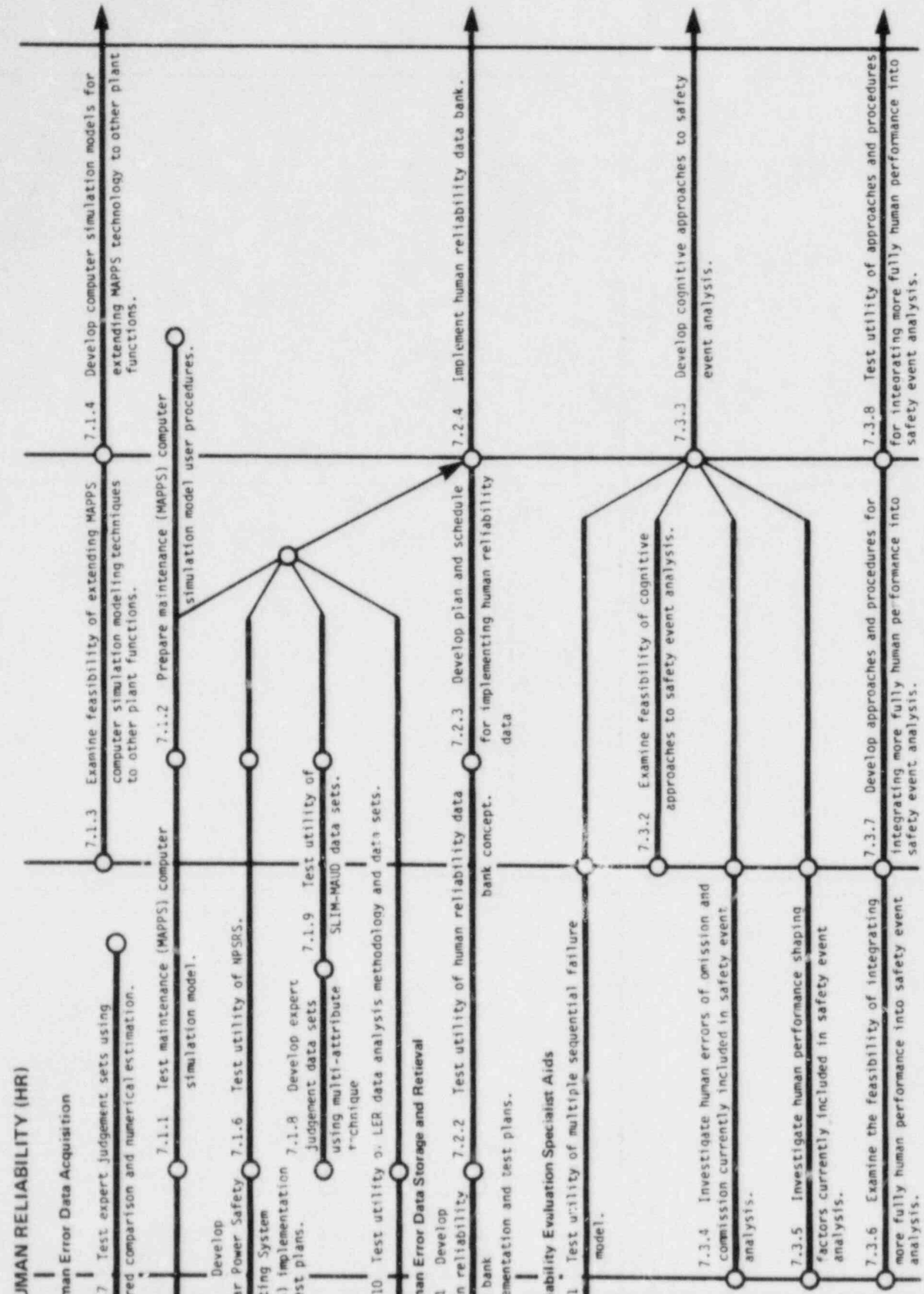

Figure III: 7.0 Human Reliabilty Activity Sequence Diagram

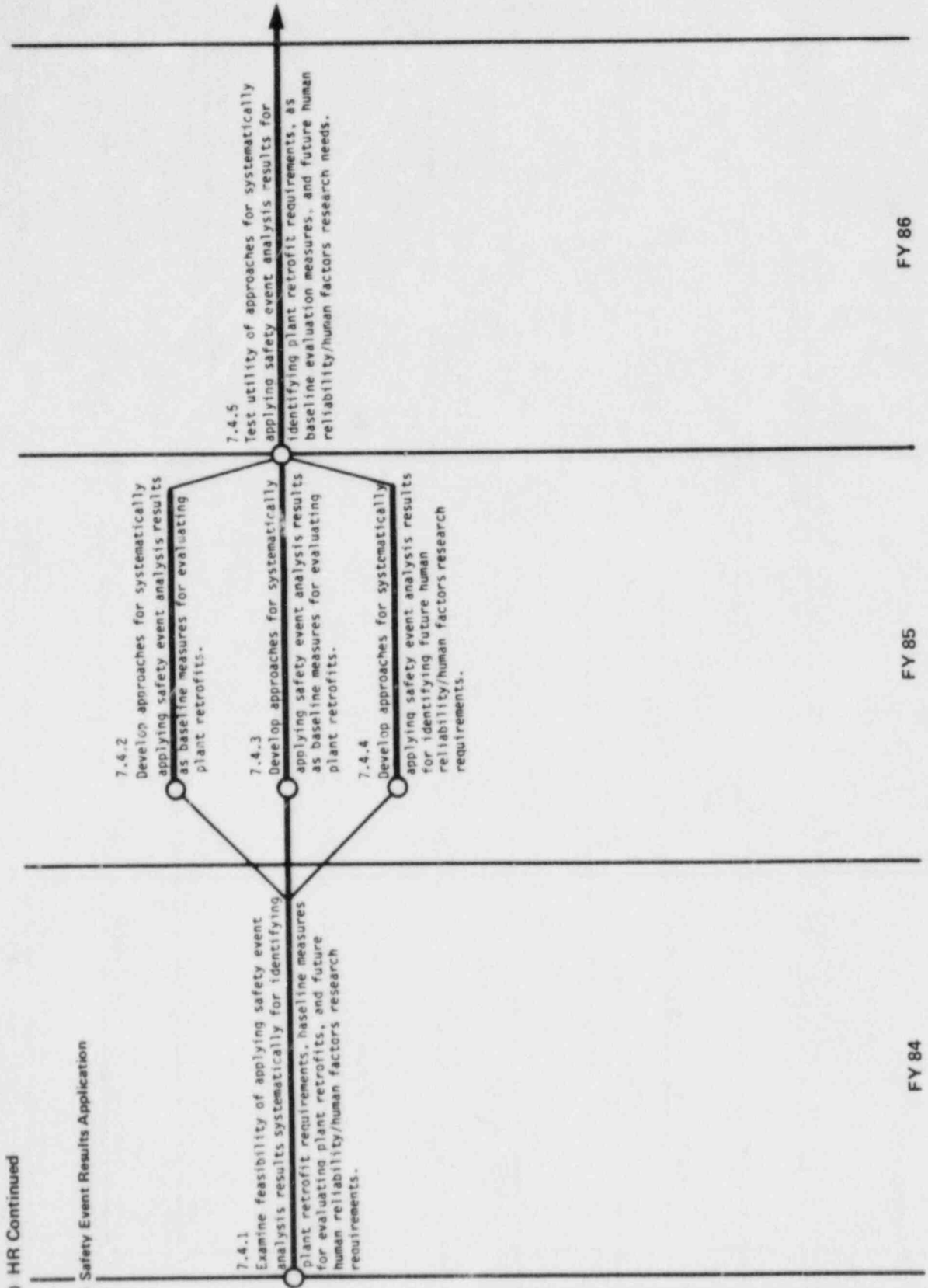

Figure 11: 7.0 Human Reliability Activity Sequence Diagram

APPENDIX A

PROGRAM ELEMENT SCHEDULES

PROGRAM PLAN

1.0 STAFFING AND QUALIFICATIONS	responsible office	FY 84 Q3	FY 84 Q4	FY 84 Q1	FY 84 Q2	FY 84 Q3	FY 84 Q4	FY 85 Q1	FY 85 Q2	FY 85 Q3	FY 85 Q4	FY 86 Q1	FY 86 Q2	FY 86 Q3	FY 86 Q4
1.1 NPP Staffing Requirements															
1.1.1 Develop shift staffing methodology.	RES														
1.1.2 Develop manpower projection models.	RES														
1.2 Minimum Qualifications Requirements															
1.2.1 Evaluate job/task analysis data for qualifications	RES														
1.2.2 Conduct simulator experiments to support regulatory positions on qualifications.	RES														
1.2.3 Policy statement on engineering expertise on shift.	NRR														
1.2.4 Evaluate effectiveness of Policy Statement.	NRR														
1.2.5 Identify job-related qualifications for operations shift crew.	NRR														
1.2.6 Evaluate benefits/feasibility of licensing or certifying personnel other than licensed operators and senior licensee officials.	NRR														
1.2.7 Develop Commission paper of regulatory position for licensing/certifying others.	NRR														
1.2.8 Develop licensing program.	NRR														
1.2.9 Develop rule on degree requirements for operating staff.	NRR														
1.2.10 Revise and evaluate changes to Regulatory Guide 1.8.	NRR/RES														
1.2.11 Review and evaluate INPO good practice manuals.	NRR														
1.2.12 Develop a means to evaluate acceptability of NPP personnel qualifications programs.	RES														
1.2.13 Develop guidance and/or regulation on operating experience on shift.	NRR														
1.3 Limits and Conditions of Shift Work															
1.3.1 Evaluate the effects of shift duration, shift arrangements and shift rotation on operator performance.	NRR/RES														
1.3.2 Evaluation current policy statement on overtime.	NRR														
1.3.3 Prepare policy statement on limits and conditions of shift work.	NRR/RES														
1.4 Fitness for Duty															
1.4.1 Revise 10 CFR Part 50.54 to include fitness for duty and revise 10 CFR Parts 50 and 73 with respect to access authorization, pat down search, vital area designation, key and lock control, and psychological assessment ("Insider" Rule).	RES														
1.5 Industry Activities															
1.5.1 Industry staffing practices survey.	INPO														
1.5.2 Job/Task analyses.	INPO														
1.5.3 Selection criteria for NPP operators.	EEI														
1.5.4 ANS 3.1 committee recommendations.	INDUSTRY														
1.5.5 Good practice manuals.	INPO														
1.5.6 NUMARC initiatives.	INDUSTRY														

PROGRAM PLAN

2.0 TRAINING	responsible office	FY 84 Q3	FY 84 Q4	FY 84 Q1	FY 84 Q2	FY 84 Q3	FY 84 Q4	FY 85 Q1	FY 85 Q2	FY 85 Q3	FY 85 Q4	FY 86 Q1	FY 86 Q2	FY 86 Q3	FY 86 Q4
2.1 Development of Training Regulation and Guidance															
2.1.1 Training reg. package (ser Sec. 306).	NRR														
(a) Revise 10CFR Part 50 (b) Develop Training R.G. (c) Revise R.G. 1.8.															
2.1.2 Develop NUREG for team training.	NRR														
2.1.3 Determine qualifications and a regulatory position for training instructors.	NRR														
2.1.4 Review existing training regulations to eliminate excess items.	NRR														
2.1.5 Operator personnel task analysis.	RES														
2.1.6 Conduct simulator experiments to support reg. positions on training.	RES														
2.1.7 Identify operator training requirements for accident management.	RES														
2.2 Develop NRC Training Evaluation Program															
2.2.1 Develop NRC training evaluation procedures.	NRR														
2.2.2 Develop revised IE/Regional inspection module.	NRR/IE/Regions														
2.2.3 Revise SRP Chapter 13.2 (training).	NRR														
2.2.4 Evaluate reg. position on industry accreditation.	NRR														
2.2.5 Training program evaluation.	RES														
2.3 Industry Activities															
2.3.1 Establish and implement an accreditation program.	INPO														
2.3.2 Conduct job/task analyses.	INPO														
2.3.3 Prepare TSD handbook.	INPO														
2.3.4 Curriculum development for licensed and non/licensed personnel.	INPO														
2.3.5 Prospective plant manager program.	INPO														
2.3.5 NUMARC initiatives	INDUSTRY														

PROGRAM PLAN

3.0 LICENSING EXAMINATIONS	responsible office	FY 84 Q3	FY 84 Q4	FY 84 Q1	FY 84 Q2	FY 84 Q3	FY 84 Q4	FY 85 Q1	FY 85 Q2	FY 85 Q3	FY 85 Q4	FY 86 Q1	FY 86 Q2	FY 86 Q3	FY 86 Q4
3.1 The Examination Content															
3.1.1 Training requirements package (Sec. 306).	NRR														
Revise 10 CFR 55; revise RGs 1.149, 1.8.							(PWR)			(BWR)					
3.1.2 Identify content and knowledge domain for licensing examinations based on job/task analyses.	NRR						(PWR)					(BWR)			
3.1.3 Develop test specifications.	NRR														
3.1.4 Update test specifications.	NRR														
3.1.5 Develop improved computerized question bank.	NRR														
3.1.6 Develop computerized knowledge catalogue.	NRR														
3.1.7 Content analysis and statistical evaluation/validation of examination and test items.	NRR														
3.1.8 Develop test specifications for requalification and other exams.	NRR														
3.1.9 Develop test specifications for research reactors, instructor certification, and fuel handlers.	NRR														
3.2 The Examining Process															
3.2.1 Identify optimal format/procedures for exam components.	NRR														
3.2.2 Develop/test simulator exam procedures.	NRR/RES														
3.2.3 Develop/implement examiner retraining programs.	NRR/IE														
3.2.4 Develop criteria and personnel requirements for simulation facility application, review, approval and audit.	NRR/RES														
3.3 Long-Term Efforts															
3.3.1 Long-term examination development and validation.	NRR/RES														
3.3.2 Identification of on-the-job performance criteria and criterion-related validation studies.	RES														
3.3.3 Evaluate check operator concept for requalification examinations.	NRR														
3.3.4 Develop/implement regional trial program of check operator concept.	NRR														
3.3.5 Effects of simulator fidelity on operator training/testing.	RES														
3.4 Industry Activities															
3.4.1 Conduct job/task analyses.	INPO														
3.4.2 Conduct plant-specific job/task analyses.	INDUSTRY														
3.4.3 Industry input on examinations and examination processes.	INDUSTRY														

PROGRAM PLAN

4.0 PROCEDURES	responsible office	Q3	Q4	FY 84 Q1	FY 84 Q2	FY 84 Q3	FY 84 Q4	FY 85 Q1	FY 85 Q2	FY 85 Q3	FY 85 Q4	FY 86 Q1	FY 86 Q2	FY 86 Q3	FY 86 Q4	
4.1 Development of Procedure Guidance and Criteria																
4.1.1 Revise the inspection module and develop associated training for regional audit of EOPs.	NRR/OIE															
4.1.2 Determine need for and develop regulatory action with respect to OPs and AOPs.	NRR															
4.1.3 Determine need for and develop regulatory action with respect to other procedures.	NRR															
4.1.4 Develop methods and evaluate alternative techniques and formats for presenting procedures.	RES															
4.1.5 Develop methods for evaluation of the in-plant effectiveness and impact of upgraded EOPs.	RES															
4.1.6 Evaluate the in-plant effectiveness and impact of upgraded EOPs.	NRR/RES															
4.1.7 Develop methods and evaluate the use of procedures under stress/ severe accidents.	NRR/RES															
4.1.8 Determine applications of artificial intelligence concepts to procedures prompting.	RES/NRR															
4.1.9 Develop guidance and regulatory action with respect to the use of computer diagnostics and artificial intelligence to support procedures.	NRR															
4.1.10 Guidance for safety/safeguards for safety-related emergency.	RES/NMSS															
4.1.11 Coordinate with industry to update technical guidelines and procedures (INPO/Owners Groups).	NRR															
4.1.12 Revise SRP 13.52 (procedures).	NRR															
SPEB/CRGR Review and Approval.	NRR/EDO															
4.1.13 Determine impacts of computer diagnostics and automation on procedures and regulatory requirements.	RES															
4.1.14 Determine the impact of severe accident research on technical guidelines and development of procedures which address severe accidents.	RES/NRR															
4.1.15 Determine the extent of interaction between safety/safeguards personnel in the event of a Safety-Related Emergency (SRE).	RES															
4.1.16 Determine human factors problems which could adversely impact safety/safeguards interactions, such as: breakdown in vigilance, inadequate training, alternative communication modes, etc.	RES															
4.1.17 Determine if existing methods and procedures at power reactors involving interactions between safety, safeguards and off-site emergency personnel need revision.	RES/NMSS															
4.1.18 Develop guidance detailing the appropriate duties and responsibilities of safety/safeguards personnel during SREs.	RES/NMSS															

PROGRAM PLAN

5.0 MAN-MACHINE INTERFACE	responsible office	Q3	Q4	FY 84 Q1	Q2	Q3	Q4	FY 85 Q1	Q2	Q3	Q4	FY 86 Q1	Q2	Q3	Q4
5.1 Man-Machine Interface Guideance for Existing Designs															
5.1.1 Local Control Stations															
5.1.1.1 Conduct task analyses of control room crew activities analyze auxiliary personnel functions.	RES														
5.1.1.2 Develop a regulatory position addressing the NRC's role in local control station design and operation.	NRR														
5.1.1.3 Analyze potential plant safety impact from auxiliary personnel human errors.	NRR														
5.1.1.4 Develop guidelines on local contral station design.	NRR														
5.1.1.5 Determine regulatory action for safeguards MMI	RES/NMSS														
5.1.2 Annunciators															
5.1.2.1 Develop guidance for annunciator improvement.	NRR/RES														
5.1.2.2 Investigate feasibility of operational aid system based on generalized alarm prioritization and procedures for existing plants.	RES														
5.1.2.3 R.G. for annunciator design.	RES														
5.2 Man-Machine Interface Guidance for Designs Based on Advanced Technologies															
5.2.1 Computers															
5.2.1.1 Develop guidance and criteria for control room data display.	RES														
5.2.1.2 Develop guidelines on contrul room information management during severe transients and accidents.	RES														
5.2.1.3 Develop regulatory guides on information management methods.	RES														
5.2.1.4 Computer based criteria for operator aiding in accident management.	RES														
5.2.2 Advanced Controls and Displays															
5.2.2.1 Provide data on evaluation methods and design criteria related to visual displays.	RES														
5.2.2.2 Establish criteria and guidelines needed for regulatory assessment of advanced control room concepts.	RES														
5.2.2.3 Identify control/display requirements for crew needs subsequent to severe seismic events.	RES														
5.2.2.4 Track new and developing technologies.	RES														
5.2.3 Function Allocation															
5.2.3.1 Establish criteria for function allocation.	RES														
5.2.4 Safety System Status Indication															
5.2.4.1 Develop guidance for long-term improvement safety system status monitors.	NRR														
5.2.4.2 Revise Regulatory Guide 1.47.	NRR/RES														

PROGRAM PLAN

5.0 MAN-MACHINE INTERFACE	responsible office	FY 84 Q3	FY 84 Q4	FY 84 Q1	FY 84 Q2	FY 84 Q3	FY 84 Q4	FY 85 Q1	FY 85 Q2	FY 85 Q3	FY 85 Q4	FY 86 Q1	FY 86 Q2	FY 86 Q3	FY 86 Q4
5.2.5 Regulatory Documents for MMI															
5.2.5.1 Develop human factors GDC.	RES														
5.2.5.2 Revise and maintain SRP Ch. 18.	NRR														
5.2.6 Industry Activities															
5.2.6.1 Annunciator research	EPRI/INDUSTRY/HALDEN														
5.2.6.2 Control room enhancement.	Halden/EPRI														
5.2.6.3 Advanced display research.	Halden/EPRI														
5.2.6.4 Guidelines for internal plant communications.	EPRI														
5.2.6.5 Guidelines for power plant alarms.	EPRI														
5.2.6.6 Computer generated display guide.	EPRI														

PROGRAM PLAN

6.0 MANAGEMENT AND ORGANIZATION	Responsible office	FY 84 Q3	FY 84 Q4	FY 84 Q1	FY 84 Q2	FY 84 Q3	FY 84 Q4	FY 85 Q1	FY 85 Q2	FY 85 Q3	FY 85 Q4	FY 86 Q1	FY 86 Q2	FY 86 Q3	FY 86 Q4
6.1 Establish Regulatory Position on Management and Organization at ORs															
6.1.1 Monitor INPO review activities.	NRR/IE														
6.1.2 Evaluation of INPO and other review criteria.	NRR/IE														
6.1.3 Staff paper on INPO criteria evaluation.	NRR														
6.1.4 Evaluate need for regulatory position.	NRR														
6.1.5 Staff paper to recommend NRC position on M&O at ORs.	NRR														
6.1.6 Develop and maintain regulatory position.	NRR/RES														
6.1.7 Develop safety performance indicators for NPP M&O.	NRR														
6.1.8 Refine objective safety-related M&O performance indicators for ORs	RES														
6.1.9 Data base of M&O functions and roles for ORs.	RES														
6.1.10 Identify safety-related M&O factors in ORs.	RES														
6.2 Development of NRC Assessment Procedures for OLs															
6.2.1 Prepare review guidelines for OLs	NRR														
6.2.2 Prepare review workbook for NRR reviewers.	NRR														
6.2.3 Publish NRC reviewer procedures.	NRR														
6.2.4 Revise SRP Chapters 13.1 and 13.4.	NRR														
6.2.5 Evaluate ISEG and safety review systems.	NRR														
6.2.6 Propose/assist in revisions to I&E M&O inspection procedures.	NRR														
6.2.7 Train technical reviewers and regional personnel in use of assessment materials.	NRR/IE														
6.2.8 Data base of M&O functions and roles for OLs.	RES														
6.2.9 Identify safety-related M&O factors for OLs.	RES														
6.2.10 Develop objective safety-related M&O indicators for OLs.	RES														
6.3 Industry Activities															
6.3.1 Evaluate program for corporate management.	INPO														
6.3.2 Work structure and performance.	EPRI														
6.3.3 Improving organizational communications.	EPRI														
6.3.4 NUMARC initiatives.	INDUSTRY														

PROGRAM PLAN

7.0 HUMAN RELIABILITY	responsible office			FY 84				FY 85				FY 86				
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
7.1 Human Error Data Acquisition																
7.1.1 Test maintenance (MAPPS) computer simulation model.	RES															
7.1.2 Prepare maintenance (MAPPS) computer simulation model user procedures.	RES															
7.1.3 Examine feasibility of extending MAPPS computer simulation modeling techniques to other plant functions.	RES															
7.1.4 Develop computer simulation models for extending MAPPS technology to other plant functions.	RES															
7.1.5 Develop Nuclear Power Safety Reporting System (NPSRS) implementation and test plans.	RES															
7.1.6 Test utility of NPSRS.	RES															
7.1.7 Test expert judgement sets using paired comparison and numerical estimation.	RES															
7.1.8 Develop expert judgement data sets using multi-attribute technique (SLIM-MAUD).	RES															
7.1.9 Test utility of SLIM-MAUD data sets.	RES															
7.1.10 Test utility of LER data analysis methodology and data sets.	RES															
7.2 Human Error Data Storage and Retieval																
7.2.1 Develop human reliability data bank implementation and test plans	RES															
7.2.2 Test utility of human reliability data bank concept	RES															
7.2.3 Develop plan and schedule for implementing human reliability data bank alone or as a part of other NRC data acquisition systems.	RES															
7.2.4 Implement human reliability data bank.	RES															
7.3 Reliability Evaluation Specialist Aids																
7.3.1 Test utility of multiple sequential failure model.	RES															
7.3.2 Examine feasibility of cognitive approaches to safety event analysis.	RES															
7.3.3 Develop cognitive approaches to safety event analysis.	RES															
7.3.4 Investigate human errors of omission and commission currently included in safety event analysis.	RES															
7.3.5 Investigate human performance shaping factors currently included in safety event analysis.	RES															
7.3.6 Examine the feasibility of integrating more fully human performance into safety event analysis.	RES															
7.3.7 Develop approaches and procedures for integrating more fully human performance into safety event analysis.	RES															
7.3.8 Test utility of approaches and procedures for integrating more fully human performance into safety event analysis.	RES															

PROGRAM PLAN

7.0 HUMAN RELIAB'LITY (cont'd)	responsible office			FY 84				FY 85				FY 86				
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
7.4 Safety Event Analysis Results Application																
7.4.1 Examine feasibility of applying safety event analysis results systematically for identifying plant retrofit requirements, baseline measures for evaluating plant retrofits, and future human reliability/human factors research requirements.	RES															
7.4.2 Develop approaches for systematically applying safety event analysis results as baseline measures for evaluating plant retrofits.	RES															
7.4.3 Develop approaches for systematically applying safety event analysis results as baseline measures for evaluating plant retrofits.	RES															
7.4.4 Develop approaches for systematically applying safety event analysis results for identifying future human reliability/human factors research requirements.	RES															
7.4.5 Test utility of approaches for systematically applying safety event analysis results for identifying plant retrofit requirements, as baseline evaluation measures, and future human reliability/human factors research needs.	RES															

NRC FORM 335 (2-84) NRCM 1102, 3201, 3202

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Program Plan

13. ABSTRACT (200 words or less)

This document is the First Annual Revision to the NRC Human Factors Program Plan originally published August 1983.

The purpose of this document is to ensure that proper consideration is given to human factors in the planning, design, construction, operation and maintenance of nuclear facilities. The plan represents a systematic and comprehensive approach for addressing human factors concerns important to nuclear power plant safety in the FY-84 through FY-86 time frame.

The plan addresses the planning of seven major program elements: 1.0 Staffing and Qualifications, 2.0 Training, 3.0 Licensing Examinations, 4.0 Procedures, 5.0 Man-Machine Interface, 6.0 Management and Organization, and 7.0 Human Reliability.

Appendix (A) Program Element Schedules.

14. DOCUMENT ANALYSIS – a. KEYWORDS/DESCRIPTORS

Program Management
Control Rooms
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Budgets

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