DEPT OF NUCLEAR TECHNOLOGY

CHULALONGKORN UNIVERSITY

Presentation - 9

" HUMAN FACTORS in DESIGN OPERATIONS and MAINTENANCE "

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OBJECTIVES of PRESENTATION

This presentation will discuss

the following topics :

- **General "Human Factors" guidelines**
- **Error- reduction considerations in :**
  - **design**
  - **operations and maintenance**
- **Human performance evaluation system (HPES)**

HUMAN FACTORS

GENERAL GUIDELINES

- **Accept human error as inevitable part of human variability**
- **Analyze errors and conditions under which they occur**
- **Assign blame with discretion**
- **Address the cause of errors not the symptoms**
- **Consider capabilities and limitations of humans**
- **Identify and design out error prone arrangements**

HUMAN FACTORS PRINCIPLES

to be considered in

DESIGN

- **Physical and mental capabilities of users**
- **Interfaces between system and user**
- **Demands which the task places on user**
- **Provision of feedback to user**
- **Information about system status**
- **Standardization for consistency and compatibility**

IMPORTANT ACTIVITIES of HUMAN FACTORS SPECIALIST

- Organizational analysis
- Task analysis
- Interface design
- Maintainability analysis
- Communication analysis
- Work place layout study
- Physical demand analysis
- Workload analysis
- Human reliability assessment

AUTOMATION - HOW MUCH ?

Considerations :

- **Allocation of function**
  - how much to automate ?
- **Interface design**
  - provision of continuous feedback
- **Training**
  - recognizing nature of the problem
  - understanding of correct action
  - anticipating results
- **Procedures**
  - provision of clear guidance
- **Continued competence - practice**
  - what, where, how often ?
- **Complexity** and potential maintenance problems

HUMAN FACTORS in OPERATIONS and MAINTENANCE

Pre-requisites :

- Management commitment
- Specialist resources
- Reporting and analysis of human error events
- Data base and learning from experience

To be addressed :

- Procedures
- Qualification and training
- Supervision
- Verification
- Internal interfaces
- Working conditions
  - Personal factors
- Performance assessment

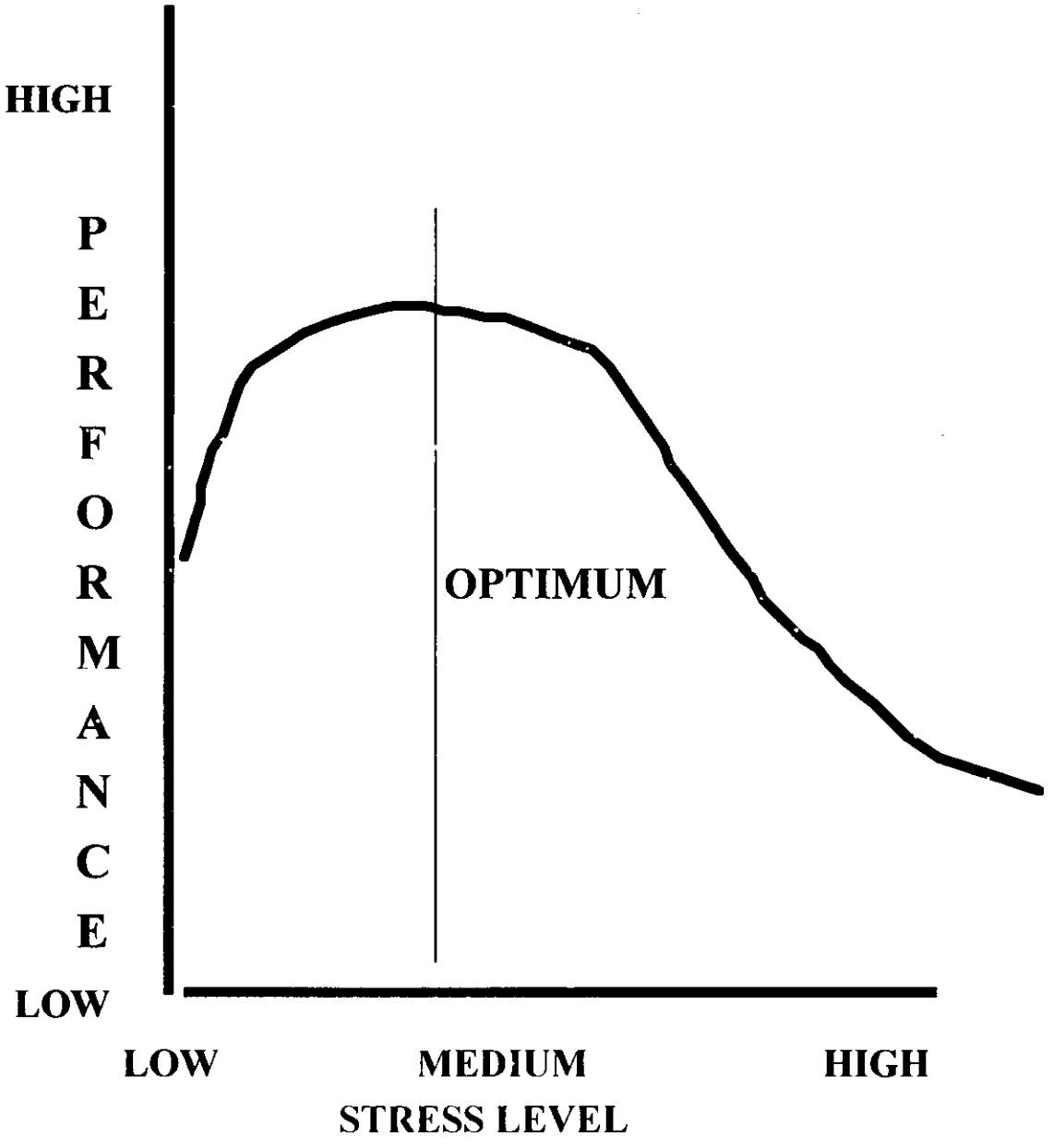
TRENDS in OPERATIONS

- **Decrease in direct operator control**
- **Increase in operator supervision**
- **Increased complexity of instrumentation and equipment**
- **Expectations of higher production**
- **When troubles arise :**
  - **more equipment to be repaired**
  - **diagnosis more difficult**

RESULT :

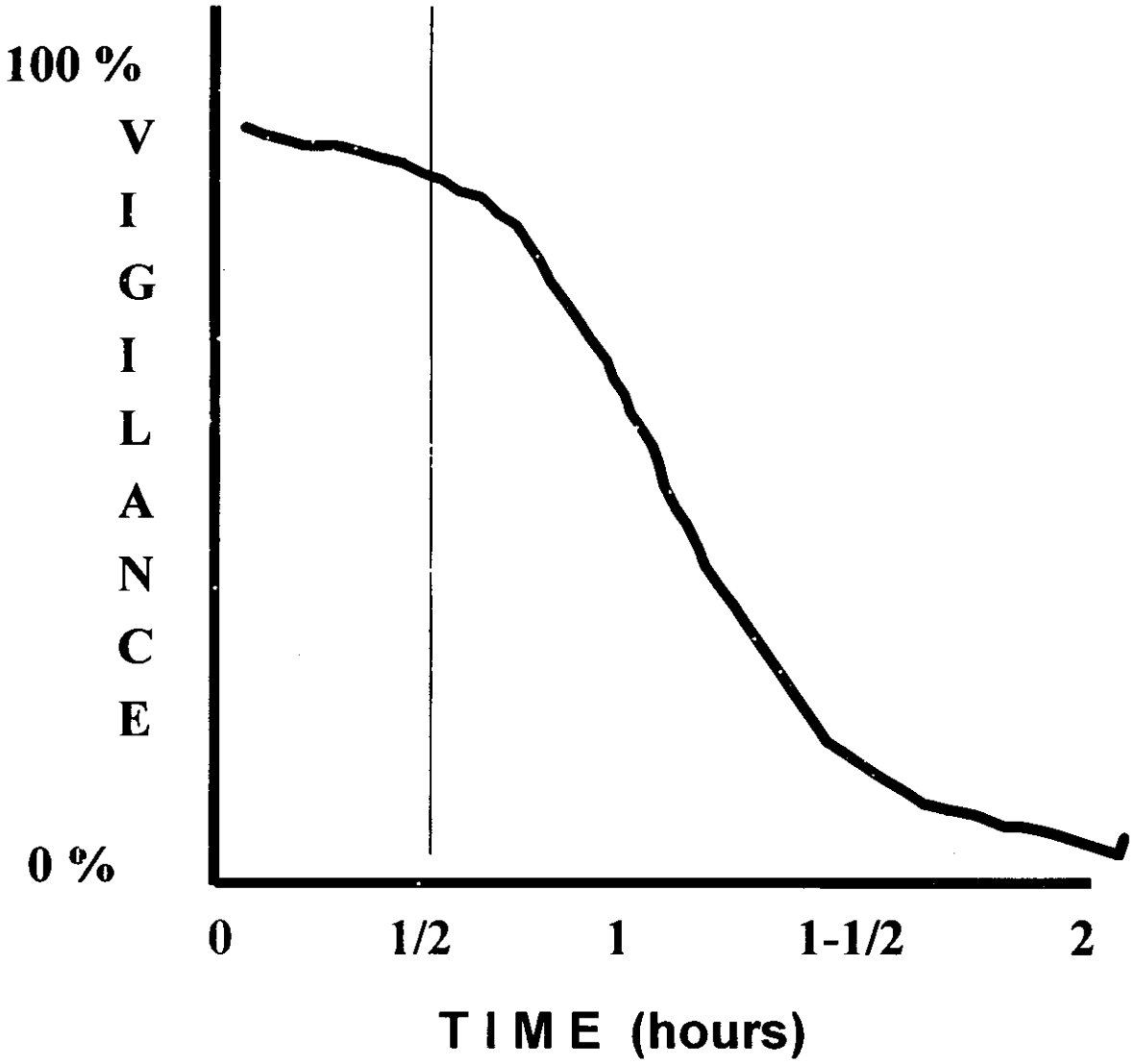
- **Source of human error shifting from operators to maintainers**
- **Better training required for maintainers**

RELATIONSHIP between PERFORMANCE and STRESS

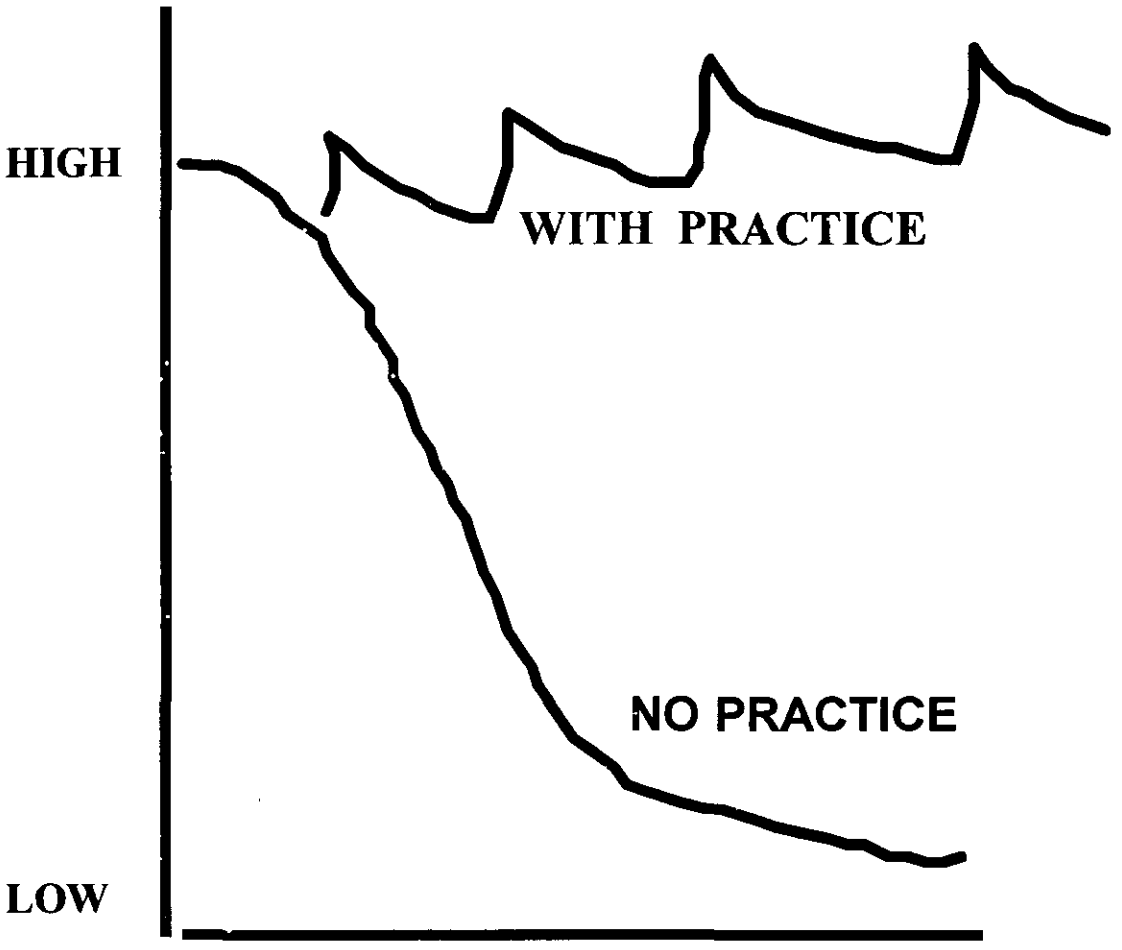


VIGILIANCE EFFECT for PASSIVE TASKS

WITH LOW SIGNAL RATE



EFFECTS of PRACTICE
on
MAINTENANCE of SKILLS

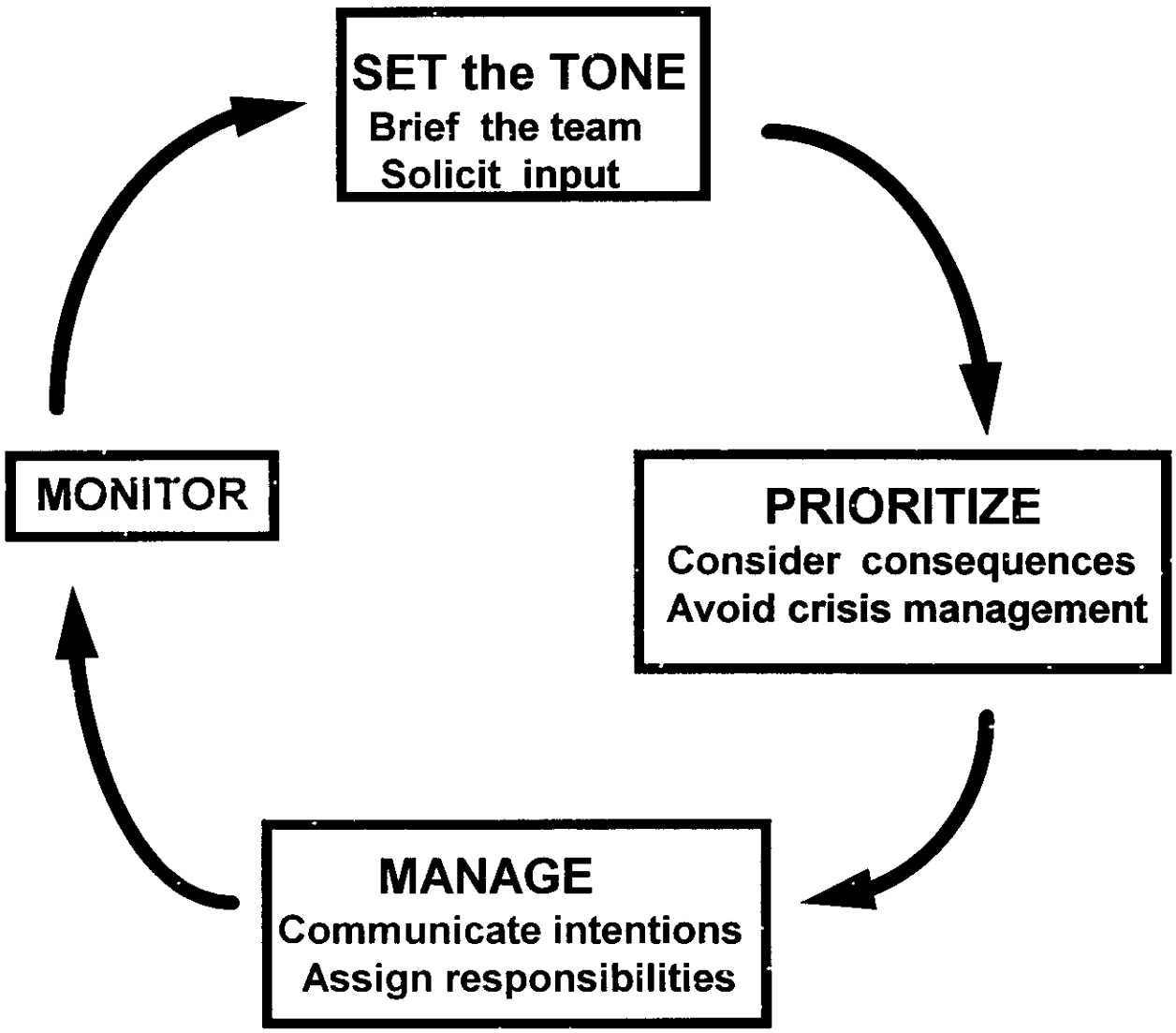


REQUIREMENTS for PROCEDURES

- **Stating the essentials**
  - **supporting details available elsewhere**
- **Technically correct and complete**
- **Clear, free of ambiguity and user friendly**
- **Contain warnings of hazards**
- **Supported by operating/maintenance aids**
- **There are no awkward actions expected**
- **Sequences of operations fit with equipment layout**
- **Consistency with operating philosophy maintained**

CREW COORDINATION

MODEL



VERIFICATION

Independent inspection and verification means that work is inspected by someone with appropriate qualifications who did not do or supervise it

Verification must be specified and documented

Verification :

- **contributes to reduction of errors**
- **increases labour and time requirements**

"S-T-A-R" is a form of self - verification

"S - T - A - R"

- **S - stop.**
  - pause before acting,
  - focus attention,
  - review details

- **T - hink**
  - what is to be done
  - identify equipment and controls
  - consider current indications

- **A - ct**
  - maintain contact with equipment
  - physically touch equipment/control
  - confirm correct equipment is being acted upon

- **R - eview**
  - verify expected response
  - if unexpected response occurs, take appropriate conservative action

INTERFACES

Symptoms of problems :

- control information misinterpreted
- alarms delayed, flooding or spurious
- information lost during shift change
- technical instructions miunderstood
- maintenance priorities do not match operations needs

Atributes of interfaces :

- clear, unobstructed communications throughout
- layout of instrumentation promotes clarity of presentation
- alarms up-to-date and alarm messages clear
- shift changes professionally executed
- operations, maintenance and technical work as a team

WORKING CONDITIONS

- **Important parameters :**
  - facility access and layout
  - maintainability and access to equipment
  - signs, labels and coding
  - illumination
  - thermal environment -temperature and humidity
  - noise and vibration
  - control room design
  - design of information displays
  - human - computer interface
- **Freedom from interference and disruption**

PERSONAL FACTORS

- **Physical demands of the job :**
  - **effects of fatigue**
  - **work posture**
  - **physical exertion**
- **Level of stress on the job :**
  - **job or supervisory demands**
  - **extent of concentration required**
  - **conflicts on the job**
- **Industrial hygiene**
  - **frequency of breaks**
  - **cafeteria and food**
  - **showers and toilets**

HUMAN PERFORMANCE EVALUATION SYSTEM (HPES)

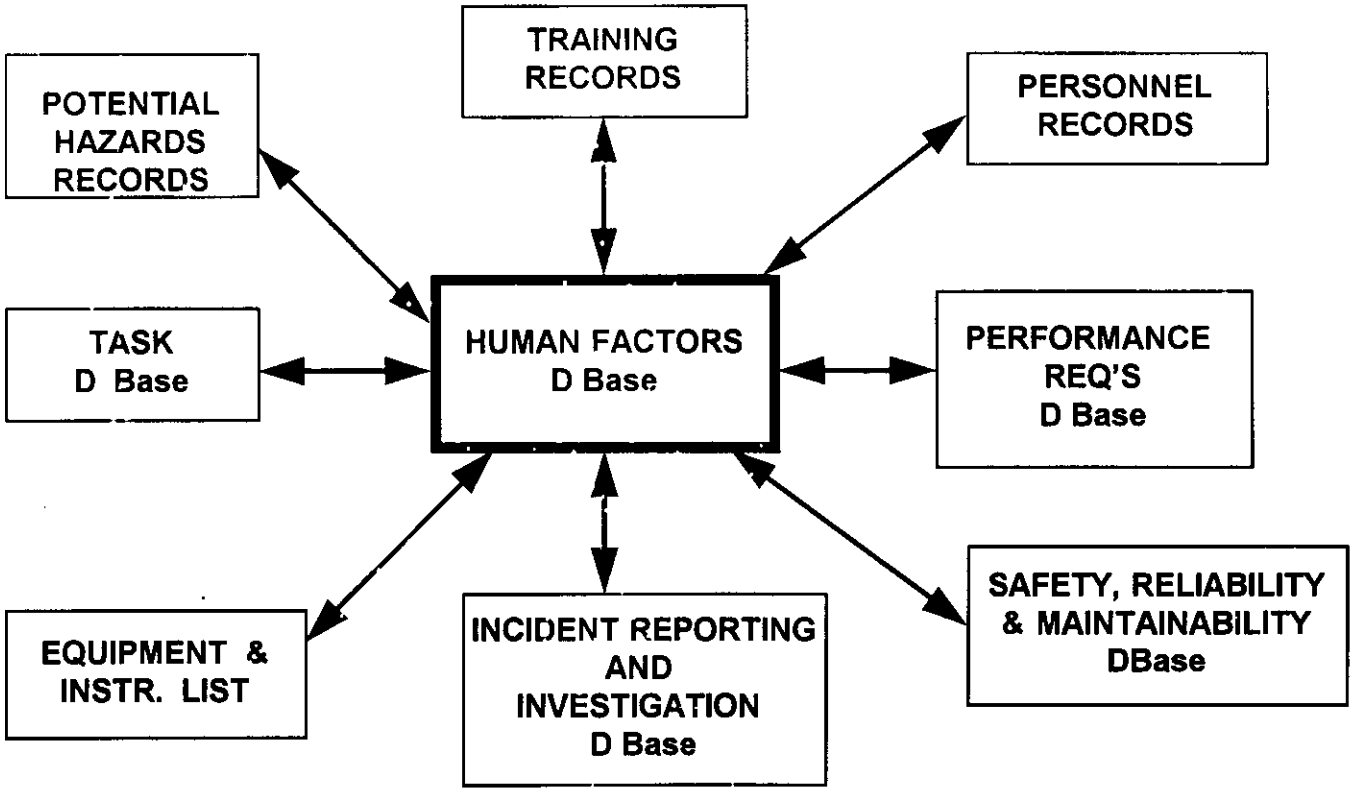
Objectives:

- to determine the causes of errors
- to specify and implement corrective action
- to monitor results of corrections

Participants in the program :

- line management :
  - uses program to resolve causes of errors
- "reporters" - all staff who report problems
- program coordinator - a specially trained
  - analyzes reported events
  - determines their causes
  - recommends corrective action
- evaluators - assist the coordinator
  - trained in analysis and evaluation
  - have detailed knowledge of equipment

INTERACTIONS BETWEEN HUMAN FACTORS and OTHER D- BASES



Supervision

JUDGEMENT

CONTROL

QUALITY

EFFECT OF SUCCESS,
FAILURE OR ERROR ON :

- Employee Safety
- Reliability
- Citizenship
- Product Cost
- Conservation