Classification system for reporting events involving human malfunctions

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CLASSIFICATION SYSTEM FOR REPORTING EVENTS INVOLVING HUMAN MALFUNCTIONS

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Abstract. The report describes a set of categories for reporting industrial incidents and events involving human malfunction. The classification system aims at ensuring information adequate for improvement of human work situations and man-machine interface systems and for attempts to quantify "human error" rates.

The classification system has a multifacetted non-hierarchical structure and its compatibility with Ispra's ERDS classification is described. The collection of the information in general and for quantification purposes are discussed. 24 categories, 12 of which being human factors oriented, are listed with their respective subcategories, and comments are given.

Underlying models of human data processes and their typical malfunctions and of a human decision sequence are described.

7 references.

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INIS-descriptors. BEHAVIOUR; DATA ACQUISITION; ERRORS; FAILURE MODE ANALYSIS; HUMAN FACTORS; INDUSTRIAL ACCIDENTS; NUCLEAR POWER PLANTS; PERSONNEL; TAXONOMY; WORK

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TABLE OF CONTENTS

INTRODUCTION

The present note is prepared to support a discussion on a set of categories which can be used in industrial incident and event reports to ensure collection of adequate information for improvement of human work situations and man-machine interface systems as well as for attempts to quantify "human error" rates.

Discussion of taxonomies to describe human tasks, performance and errors seems to be an everlasting activity among human factors specialists and the field is not very attractive after several not too successful attempts. However, if one wishes to quantify human errors, one has to identify and define the items one wants to count or measure and unless the development of modern man--machine interfaces should be controlled by piecemeal remedies after spectacular man-machine misfits - such as e.g. TMI - it is necessary to use models of human performance and define categories of problems. The basic issue is, probably, that one has to accept that the structure and members of a proper taxonomy depend very much on the intended use and the specific aspects of the work situation. One important present aspect is the rapid change in level of automation and in design of interface caused by modern information technology. Consequently, human work situation changes and the taxonomy used must be helpful for transfer of empirical data to new task designs.

The structure of the taxonomy

To be able to quantify the frequency of inappropriate human acts in a meaningful way, it is necessary to separate cases of intrinsic human variability and spontaneous human errors from cases of psychologically normal human reactions to external events or changes in the work situation. This means that a simple classification of human errors with reference to the task sequence in terms of omission, commission, timing errors etc. is not adequate. Careful efforts should be spent to identify potential external causes with reference to categories which allow estimates of frequencies in another particular situation.

To serve as a basis for more error tolerant task and equipment design, more fundamental understanding of human malfunction in industrial work situations is needed. Event reports are an extremely valuable data source for such research, but for this purpose it is important to use a taxonomy which serve to represent the circumstances preceding and succeeding the event of human malfunction and the relation to the human task, and maintain this information in the data recorded. This leads to a multifacetted description of the human involvement in system failures as shown in Figure 1, rather than a classical, heirarchical and exclusive classification system.

The structure of this taxonomy is more important than the detailed classes related to the different facets. Some of these will depend on the specific system in question; others are preliminary classes which should be refined by future data collection and analysis. Therefore, free text comments and descriptions in the reports are necessary and the facets used in the present taxonomy can serve to indicate the type of information needed.

Emphasis has been given to obtain compatibility between the human malfunction taxonomy and the taxonomy of the European Reliability Data System under development at ISPRA (Mancini et al. 1979). The combination of the taxonomies is described in the following.

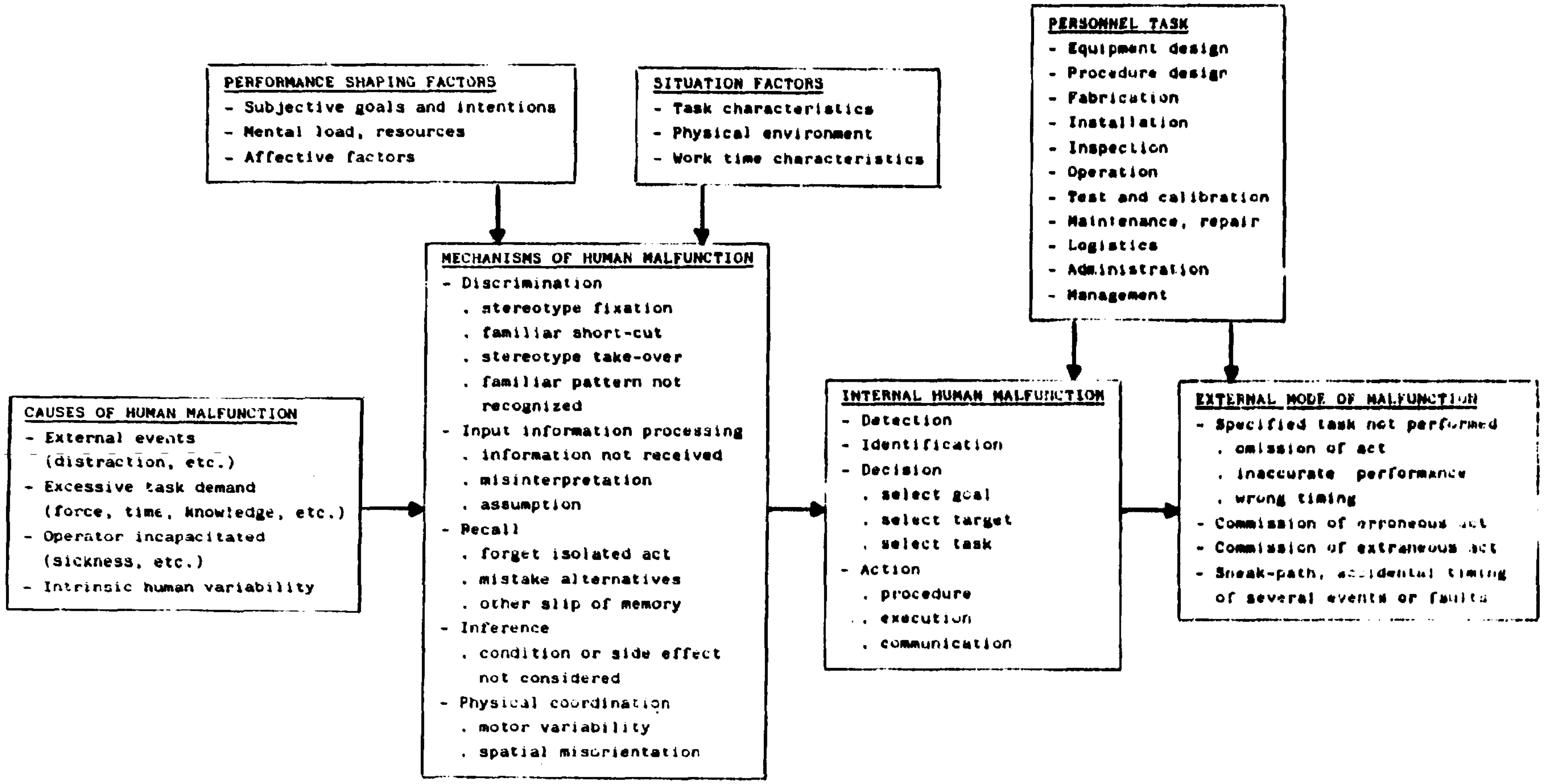

Figure 1. Multifacetted taxonomy for description and analysis of events involving human malfunction.

Collection of data, general

The means of data collection are tightly coupled to the taxonomy and its purpose: They should together constitute a good compromise between the following requirements:

- The reporting procedure should not be too difficult or require special insight (e.g. in human factors) in excess of what is reasonable from the people involved in reporting.
- The information reported should be covering and unambiguous with respect to its intended use.

It is foreseen that a good compromise can be developed only by an iterative process: the experiences from the practical event reporting and use of the information collected can be expected to lead to changes of both the reporting procedure and the taxonomy.

The above will be discussed more detailed in the following, referring to Figure 2, where the categories of the taxonomy are related to their use for event reporting and for analysis.

In order to facilitate event recording, preprinted forms will be used for categories, where reporting can be done in-plant by filling in such forms like checklists. At the outset the following categories are considered suitable for this kind of reporting:

- PLANT:
  PLANT IDENTIFICATION
  DATA SYSTEM IDENTIFICATION
- EVENT ANALYSIS:
  EVENT DETECTION
  PLANT STATE
  SYSTEMS AND COMPONENTS AFFECTED
  CONSEQUENCES OF THE EVENT
  RECOVERY SITUATION
- COMPONENT RELIABILITY DATA SYSTEM:
  MODES OF FAILURE
  CAUSES OF FAILURE
  ACTIONS TAKEN
- HUMAN SYSTEM:
  PERSONNEL IDENTIFICATION
  PERSONNEL LOCATION

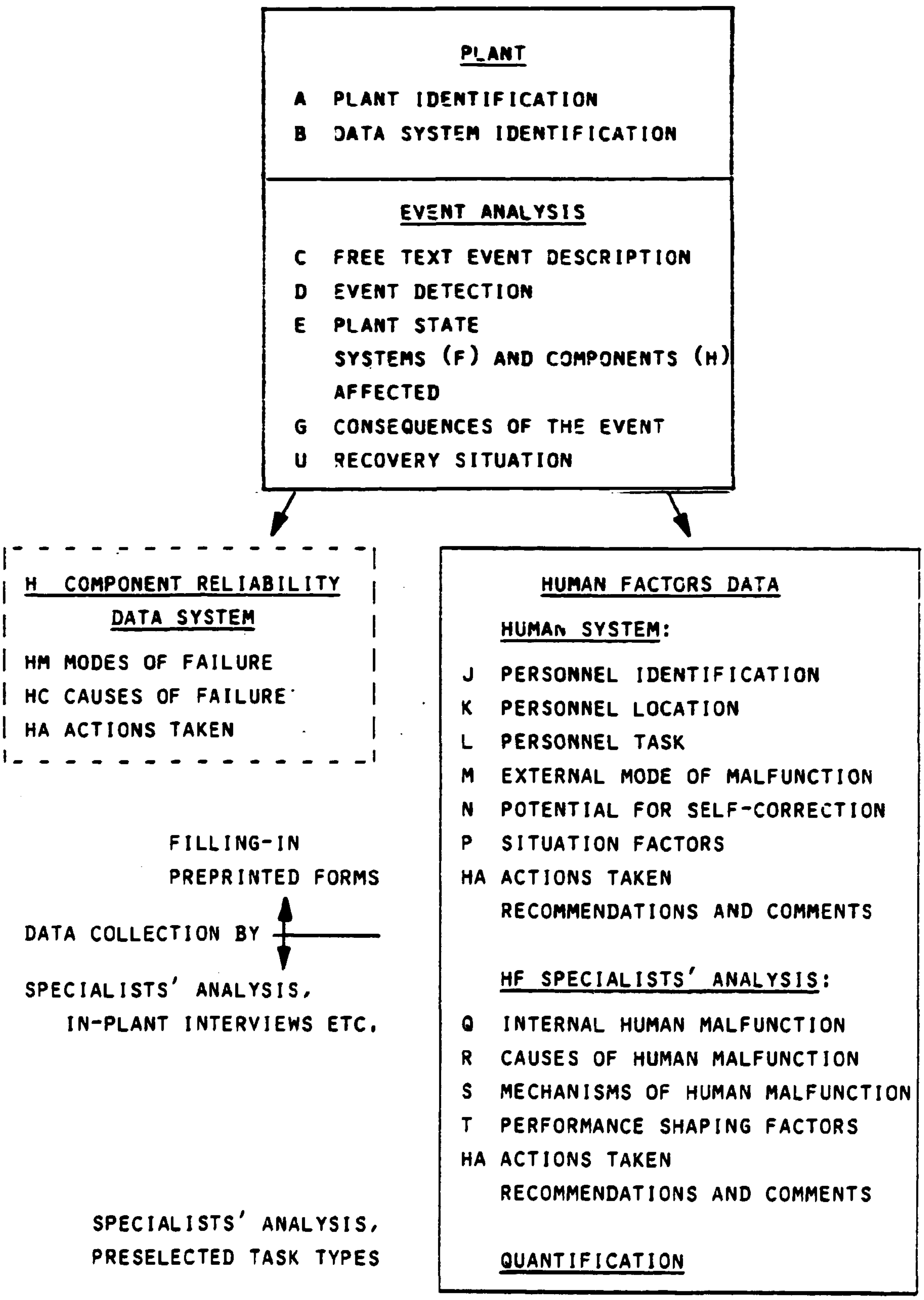

Figure 2: Use of human malfunction taxonomy.

PERSONNEL TASK
EXTERNAL MODE OF MALFUNCTION
POTENTIAL FOR SELF-CORRECTION
SITUATION FACTORS
ACTIONS TAKEN

The preprinted forms and examples of their use are presented in the document SINDOC (81)15.

FREE TEXT EVENT DESCRIPTION is intended for a short general description, abt. 10 lines of text.

The category U: RECOVERY SITUATION has been reserved for the purpose of characterizing the short term remedies applied in order to cope with a particular event. This category should be distinguished from categories HA: COMPONENTS: ACTIONS TAKEN and HA: ACTIONS TAKEN describing the long term remedies applied.

RECOVERY SITUATION has not yet been provided with subcategories and will not be discussed further in this report.

The categories SYSTEMS AND COMPONENTS AFFECTED are intended for characterization of both technical failures and human malfunctions. In case of a technical failure the classification thereafter will continue in the COMPONENT RELIABILITY DATA SYSTEM indicated by H in figure 2, specifying MODES and CAUSES OF FAILURE and ACTIONS TAKEN. In case of a human malfunction, SYSTEMS AND COMPONENTS AFFECTED will specify the physical contact/interface between the technical system and the human activity, as explained later in the comments given to this category.

The RECOMMENDATIONS AND COMMENTS under HUMAN FACTORS DATA are intended for supplementary information for the categories under HUMAN SYSTEM and, particularly, for supporting the more subtle classification under the categories:

- HF SPECIALISTS' ANALYSIS:
  INTERNAL HUMAN MALFUNCTION
  CAUSES OF HUMAN MALFUNCTION
  MECHANISMS OF HUMAN MALFUNCTION
  PERFORMANCE SHAPING FACTORS
  ACTIONS TAKEN

The classification of these categories is considered to need human factors specialists' analysis, at least in the beginning, and also will involve e.g. in-plant interviews.

As indicated in Figure 2, the categories under PLANT and EVENT ANALYSIS are expected to be common to the component reliability data system under development at ISPRA (Mancini et al. 1979) and the taxonomy discussed in this report.

In case of events involving several subevents, e.g. component failure and human malfunction or several human malfunctions, the free text description and the three categories A, B and D could be common to the subevents, these being thereafter classified as independent events.

Collection of data for quantification

When data collection is planned for quantification of human error rates special categories of information must be derived from task analysis.

- "Denominator" information must be found, i.e. the frequency of opportunity for the relevant categories of human malfunction. For some spontaneous human errors this frequency is related to the task frequency; for malfunctions with external causes the relation to task frequency is more complex and the task frequency can only be used as denominator for estimation of error rates in work situations very similar to those of the plant serving as data source.
- Recovery factors: for use in quantification of human malfunction, features of the work situation related to the potential for detection of errors by the person himself is very important and should be emphasized in the task analysis aiming at denominators.

A PLANT IDENTIFICATION

A1 Power reactors:

A1.1 BWR

A1.2 PWR

A1.3 Gascooled reactors, AGR, Magnox

A1.4 Fast breeder reactors

A1.5 Heavy water reactors

A2 Research reactors

A3 Other. Fuel manufacturing and reprocessing, transport etc.

<u>Comments</u>

In a data retrieval system extended to more industrial branches than that of nuclear power, the specific branches could be typified according to existing proven indexing systems.

B DATA SYSTEM IDENTIFICATION

Comments

The content of this category, having not yet been worked out in details, should include descriptors characterizing items such as:

- Identification code for the data system in relation to other corresponding data systems.
- Whether or not the event is comprising several subevents.
- Individual code numbers for the reported event and subevents, if any, also covering follow-up or supplementary information reported after the preliminary event report.
- Date of event occurrence and date of report.
- Individual code number for the power station unit (reactor) involved.

D EVENT DETECTION

D1 Announced by automatic alarm

D2 During maintenance:
D2.1 Planned/preventive
D2.2 Repair/modification

D3 During test or special inspection

D4 During operational activities
(excluding automatic alarm announcing):
D4.1 Preparatory activities
D4.2 When calling system into operation
D4.3 Routine surveillance during operation
D4.4 Other not covered above

D5 During management activities:
D5.1 Review of log, recorder charts
D5.2 Other

D6 Malfunction "seen, found" without further specification

D7 Not stated, not applicable

Comments

Event detection, i.e. information regarding the way the abnormality was detected, is important to judge the role and quality of the various measures to monitor the operational state of the system. The information also makes it possible to estimate the time interval from different categories of technical faults and inappropriate human acts to their detection.

E	PLANT STATE
E1	Under construction
E2	Preoperational, startup or power ascension tests (in progress)
E3	Routine startup operations
E4	Routine shutdown operations
E5	Steady state operation
E6	Stretch-out operation
E7	Load changes during routine power operation
E8	Shutdown (hot or cold) except refueling
E9	Refueling
E10	Other (including special tests, emergency shutdown operations, etc.)
E11	Not applicable, not stated

Comments

The plant state should refer to the occurrence of the malfunction. (The recognition of the malfunction is classified under the category: EVENT DETECTION).

SYSTEMS (F) AND COMPONENTS (H) AFFECTED

F Systems

F A - NUCLEAR HEAT SYSTEM

- F A1 - Reactor Core System
- F A2 - Reactor Vessel Equipment
- F A3 - Primary Coolant System (PWR)
- F A4 - Pressurizing System (PWR)
- F A5 - Steam Generator System (PWR)
- F A6 - Recirculating Water System (BWR)
- F A7 - Coolant System (BWR)
- F A8 - Control Rod System (PWR)
- F A9 - Control Rod System (BWR)

F B - ENGINEERED SAFETY FEATURES

- F B1 - Reactor Containment System (PWR)
- F B2 - Reactor Containment System (BWR)
- F B3 - Containment Spray System
- F B4 - Containment Isolation System
- F B5 - Containment Pressure Suppression System (BWR)
- F B6 - Pressure Relief System (PWR)
- F B7 - Hydrogen Venting System
- F B8 - Post-Accident Containment Atmosphere Mixing System
- F B9 - Containment Gas Control System
- F B10 - Auxiliary Feedwater System (PWR)
- F B11 - Reactor Core Isolation Cooling System (BWR)
- F B12 - Emergency Boration System (PWR)
- F B13 - Stand-by Liquid Control System (BWR)
- F B14 - Residual Heat Removal System (PWR)
- F B15 - Residual Heat Removal System (BWR)
- F B16 - High Pressure Coolant Injection System (PWR)
- F B17 - Accumulation System (PWR)
- F B18 - Low Pressure Coolant Injection System (PWR)
- F B19 - Nuclear Boiler Overpressure Protection System (BWR)
- F B20 - High Pressure Core Spray System (BWR)
- F B21 - High Pressure Coolant Injection System (BWR)
- F B22 - Low Pressure Core Spray System (BWR)
- F B23 - Low Pressure Coolant Injection System (BWR)

F C - REACTOR AUXILIARY SYSTEM

- FC1 - Chemical and Volume Control System (PWR)
- FC2 - Reactor Water Cleanup System (BWR)
- FC3 - Boron Recovery System (PWR)
- FC4 - Reactor Treated Water Storage System (PWR)

FC5 - Primary Component Cooling Water System
FC6 - Control Rod Drive Cooling Water System (PWR)
FC7 - Primary Loads Service Water System
FC8 - Ultimate Heat Sink System
FC9 - Refueling Water System
FC10 - Reactor Water Storage System (BWR)
FC11 - Radwaste Cooling Water System
FC12 - Safety Equipment Compressed Air System
FC13 - Nuclear System Fire Protection System
FC14 - Hydrogen, Oxygen, Nitrogen Gas Distribution System
FC15 - Nuclear System Building Servicing Equipment

FD - FUEL STORAGE AND HANDLING SYSTEM

FD1 - Fuel Storage and Handling Equipment
FD2 - Spent Fuel Pool Cooling and Cleanup System
FD3 - Containment Pool Cooling and Cleanup System (BWR)

FE - RADIOACTIVE WASTE MANAGEMENT SYSTEM

FE1 - Liquid Radwaste System
FE2 - Solid Radwaste System
FE3 - Gaseous Radwaste System (PWR)
FE4 - Gaseous Radwaste System (BWR)
FE5 - Equipment and Floor Drainage System
FE6 - Recovered Water Storage and Distribution System
FE7 - Steam Generator Blowdown System (PWR)

FF - STEAM AND POWER CONVERSION SYSTEM

FF1 - Main Steam System
FF2 - Turbine System
FF3 Turbine Steam Sealing System
FF4 - Main Condenser System
FF5 - Non-Condensable Gases Extraction System
FF6 - Turbine Bypass System
FF7 - Steam Extraction System
FF8 - Condensate and Feedwater System
FF9 - Moisture Separators, Reheaters System
FF10 - Moisture Separators, Reheaters Drain System
FF11 - Heaters Drain and Vents System
FF12 - Various Thermal Cycle Drains and Vents System
FF13 - Chemical Additive Injection System
FF14 - Condensate Demineralizer System
FF15 - Circulating Water System (open cycle)
FF16 - Circulating Water System (closed cycle)
FF17 - Circulating Water Treatment System
FF18 - Cooling Towers System

F G - POWER TRANSMISSION SYSTEM

FG1 - Generator System
FG2 - Main Bus Duct System
FG3 - Main Transformers System
FG4 - Auxiliary Transformers System
FG5 - Back-up Auxiliary Transformers System
FG6 - Switchyard to Station H. V. Connection

FH - ELECTRIC POWER SYSTEM

FH1 - Medium Voltage System
FH2 - Low Voltage System
FH3 - Vital Instrument and Computer A. C. System
FH4 - On-Site D. C. System
FH5 - Diesel Generator System
FH6 - Electrical Heat Tracing System
FH7 - Lighting and Taxed Motive Power System
FH8 - Security System
FH9 - Communication System
FH10 - Cathodic Protection System
FH11 - Grounding System

FI - INSTRUMENTATION, SUPERVISION, MONITORING SYSTEM

FI1 - Computer System
FI2 - Alarm System
FI3 - Main Control Room Benchboards System
FI4 - In-Core and Ex-Core Neutron Monitoring System
FI5 - Radiation Monitoring System
FI6 - Reactor Coolant Pressure Boundary Leak Detection System
FI7 - Containment Leak Detection System
FI8 - Failed Fuel Detection System (PWR)
FI9 - Main Steam Line Radiation Monitoring System (BWR)
FI10 - Hydrogen Monitoring System (BWR)
FI11 - Off-Site Radiological Monitoring System
FI12 - Seismic Monitoring System
FI13 - Meteorological Monitoring System
FI14 - Sampling System
FI15 - Perturbographic System
FI16 - Cooling Water Temperature Monitoring System

FL - PROTECTION AND CONTROL SYSTEM

FL1 - Reactor Protection System
FL2 - BOP Protection System
FL3 - Engineered Safety Features Actuation System
FL4 - Reactor Power Control System (PWR)
FL5 - Reactor Power Control System (BWR)

FL6 - Recirculation Flow Control System (BWR)
FL7 - Feedwater Control System (BWR)
FL8 - Pressure Regulator System (BWR)
FL9 - Turbine Control System
FL10 - Remote Shutdown System
FL11 - Remote Control Logic System

FM - PLANT BUILDINGS HVAC SYSTEM

FM1 - Containment Recirculation Air Cooling System
FM2 - Containment Air Purification and Cleanup System (PWR)
FM3 - Drywell Recirculation Air Cooling System (BWR)
FM4 - Containment Purge System
FM5 - Containment Low Purge and Pressure Control System (BWR)
FM6 - Drywell Purge System (BWR)
FM7 - Containment Pressure Relief System (PWR)
FM8 - Anulus Recirculation and Exhaust System
FM9 - In-Core Instrumentation Purge System
FM10 - Control Rod Drive Mechanism Cooling System (PWR)
FM11 - Reactor Auxiliary Building HVAC System
FM12 - Control Room Building HVAC System
FM13 - Fuel Building HVAC System
FM14 - Emergency Diesel Generator Building HVAC System
FM15 - Radwaste Building HVAC System
FM16 - Solid Waste Storage HVAC System
FM17 - ESF Vaults HVAC System
FM18 - Controlled Area Service Building HVAC System
FM19 - Ultimate Sink Structure HVAC System
FM20 - Main Pipe Chase HVAC System
FM21 - Interbuildings Corridors and Tunnels HVAC System
FM22 - Auxiliary Feedwater Pumps Chase HVAC System (PWR)
FM23 - Plant Stack and Vent Air Discharge System
FM24 - Turbine Building HVAC System (PWR)
FM25 - Turbine Building HVAC System (BWR)
FM26 - Non-Essential Switchgear Building HVAC System
FM27 - General Service Building HVAC System

FN - SERVICE AUXILIARY SYSTEM

FN1 - Service Water System
FN2 - BOP Cooling Water System
FN3 - Chilled Water System
FN4 - Demineralized Water Production and Distribution System
FN5 - Raw Water Make-up System
FN6 - Pretreated Water Distribution System
FN7 - Potable and Sanitary Water System
FN8 - Auxiliary Steam and Hot Water System
FN9 - Auxiliary Boiler
FN10 - Non-Radioactive Waste Treatment System

F N11 - Service and Instrument Compressed Air System
F N12 - BOP Sampling System
F N13 - Industrial Water System
F N14 - Diaphragm Bailing System
F N15 - BOP Fire Fighting System
F N16 - Service Equipment System

FO - STRUCTURAL SYSTEMS

F O1 - Reactor Auxiliary Building
F O2 - Fuel Storage Building
F O3 - Turbine, Condensate Treatment and Heater Bay Building
F O4 - ESF Vaults
F O5 - Radwaste Treatment Building and Tank Farm
F O6 - Solid Waste Storage Structure
F O7 - Control Room Building
F O8 - Emergency Diesel Generator Buildings and Diesel Generator Fuel Storage
F O9 - Ultimate Heat Sink Structure
F O10 - Controlled Area Service Building
F O11 - Circulating Water Structure
F O12 - Miscellaneous Shared Buildings and Structure.

H Components

H1 ANNUCIATOR MODULES

H1A Audio
H1B Visual
H1C Audio/Visual

H2 MECHANICAL FUNCTION UNITS

H2A Controller/Governor
H2B Coupling
H2C Power Transmission Device

H3 PENETRATIONS, PRIMARY CONTAINMENT

H3A Personnel Access
H3B Fuel Handling
H3C Equipment Access
H3D Electrical
H3E Instrument Line
H3F Process Piping

H4 **RECOMBINERS**

H4A Flame
H4B Catalytic
H4C Thermal

H5 **RELAYS**

H6 **SHOCK SUPRESSORS/SUPPORT**

H6A Hangers
H6B Supports
H6C Stabilizers
H6D Snubbers

H7 **GENERATORS**

H7A Alternator
H7B Converter
H7C Dynamotor
H7D Generator
H7E Amplidyne
H7F Inverter

H8 **FUEL ELEMENTS**

H9 **VESSELS**

H9A Reactor Vessel
H9B Pressurizer Vessel
H9C Containment/Drywell
H9D Pressure Suppression

H10 **BATTERIES**

H10A Lead
H10B Nickel Cadmium

H11 **CIRCUIT CLOSER/INTERRUPTERS**

H11A Circuit Breaker
H11B Contractor
H11C Controller
H11D Starter
H11E Switch
H11F Switchgear

H12 **ELECTRICAL CONDUCTORS**

H12A Bus
H12B Control Cable
H12C Power Cable
H12D Signal Cable
H12E Thermocouple Extension Wire

H13 **CONTROL RODS**

H14 **HEATERS**

H14A Electric
H14B Fuel Oil
H14C Gas

H15 **BLOWERS**

H15A Compressor
H15B Gas Circulator
H15C Fan
H15D Ventilator
H15E Vacuum

H16 **HEAT EXCHANGERS**

H16A Heater/Superheater
H16B Boiler
H16C Cooler
H16D Condenser
H16E Evaporator
H16F Steam Generator
H16G Heater/Cooler
H16H Desuperheater
H16J Reheater

H17 CHARGE/DISCHARGE MACHINE

H18 DEMINERALIZERS

H18A Anion
H18B Mixed Bed
H18C Cation

H19 CONTROL ROD DRIVE MECHANISM

H20 PUMPS

H20A Axial
H20B Centrifugal
H20C Diaphragm
H20D Gear
H20E Reciprocating
H20F Radial
H20G Rotary
H20H Vane Type
H20J Electromagnetic
H20K Jet

H21 TRANSFORMER

H21A Power
H21B Voltage
H21C Current
H21D Variable
H21E Isolation
H21F Power Step-up
H21G Power Step-Down

H22 ELECTRIC BOARDS/PANELS

H23 TURBINES

H23A Condensing
H23B Noncondensing
H23C Combustion
H23D Hydro
H23E Air

H24 PIPES, FITTINGS

H24A Orifice/Diaphragm
H24B Nozzle/Safe End
H24C Rupture Diaphragm
H24D Straight Section
H24E Thermowell
H24F Mixers
H24G Meters (Flow)

H25 FILTER/STRAINERS

H25A Membrane
H25B Mechanical Restriction
H25C Porous Solid
H25D Chemical
H25E Gravity
H25F Centrifugal
H25G Electrostatic
H25H Self-Clean
H25J Drum

H26 DIESEL-GENERATOR (SETS)

H26A 2-Stroke in Line
H26B 2-Stroke "V"
H26C 4-Stroke in Line
H26D 4-Stroke "V"
H26E 2-Stroke Radial
H26F 4-Stroke Radial

H27 SENSORS/INSTR. AND CONTROL

H27A Vibration
H27B Position
H27C Pressure
H27D Flow
H27E Temperature
H27F Level/Frequency
H27G Neutronic
H27H Nuclear (Radioprot.)

:28 **MOTORS**

:28A Electric

:28B Hydraulic

:28C Pneumatic

:29 **VALVES**

:30 **VALVE OPERATORS**

:30A Electric Motor

:30B Hydraulic

:30C Pneumat./Diaphragm/Cylinder

:30D Solenoid

:30E Float

:30F Explosive

:30G Mechanical (Pressure)

H31 **RECTIFIERS**

H31A Charger

H32 **CONTAINMENT INTERN. STRUCTURE**

H33 **FUEL TRANSFERT DEVICE**

H34 **ACCUMULATORS**

H34A Liquid Pressurized

H34B Liquid Unpressurized

H34C Gas

H35 **AIR/GAS DRYERS**

Comments

The categories SYSTEMS AND COMPONENTS AFFECTED are including rather detailed subclasses since this part of the taxonomy is intended to cover technical failures as well as human malfunctions. When backtracking to find the cause of an abnormal event, a technical failure may be identified and localised in terms of systems and components affected. If no technical fault is identified, we have a case of human malfunction and the categories then specify the physical contact/interface between the technical system and the human activity. It may be identified as the last technical item found when backtracking the cause of the event. Component identification is considered important for the analysis of malfunctions in test, calibration and maintenance, however, a very detailed classification not being necessary. Correlation/compatibility with other (international) classification systems should be emphasized, therefore, the ISPRA classifications developed/under development are adopted. These classifications are intended for use in the ISPRA Component Event Data Bank, see Mancini et al. 1979.

HM	COMPONENTS: MODE OF FAILURE
HM1	<u>Demanded change of state is not achieved</u> *
HM1.1	won't open
HM1.2	won't close
HM1.3	neither opens nor closes/does not switch
HM1.4	fails to start
HM1.5	fails to stop
HM1.6	fails to reach design specifications
HM2	<u>Change in conditions (state)</u>
HM2.1	Classification as for suddenness and degree:
HM2.1.1	catastrophic failure
HM2.1.2	incipient failure
HM2.2	Classification as for observed state of the component:
HM2.2.1	no output
HM2.2.2	outside specifications **
HM2.2.3	operation without request
HM2.2.4	erratic output (false, oscillating, instability, drifting etc.

* The definitions are of general nature and have to be properly interpreted for the various items.

** Including failure of item part found and repaired during preventive maintenance.

<u>Comments</u>

The ISPRA classification is adopted, see Mancini et al. 1979.

Correlation/compatibility with other (international) classification systems should be emphasized, therefore, the ISPRA classifications developed/under development are adopted. These classifications are intended for use in the ISPRA Component Event Data Bank, see Mancini et al. 1979.

HC	COMPONENTS: CAUSES OF FAILURE
HCA	Engineering
HCA1	engineering/design (hardware)
HCA2	engineering/design (proced./specificat.)
HCA3	other causes related to engineering
HCB	Manufacturing (in workshop)
HCC	Installation/construction (in situ)
HCD	Plant operation
HCD1	personnel error
HCD2	incorrect procedure/instructions
HCE	Maintenance, Testing, Measuring
HCE1	personnel error
HCE2	incorrect procedure/instructions
HCF	Material incompatibility (unexpected)
HCG	Expected wear, aging, corrosion, erosion, distortion, abrasion
HCH	Abnormal service condition
HCL	Pollution
HCM	Failure caused by other plant devices, by associated devices, or by off-site influence.
HCN	Unknown
HCO	Others (NOC)

Comments

The ISPRA classification is adopted, see Mancini et al. 1979.

HA COMPONENTS: ACTIONS TAKEN

HA2.1 Corrective Action

HA2.1.1 Corrective maintenance

HA2.1.1.1 repair without disassembly

HA2.1.1.2 repair with partial disassembly

HA2.1.1.3 repair with total disassembly

HA2.1.1.4 recalibration, reseal, repack

HA2.1.1.5 adjust

HA2.1.1.6 repair part(s)

HA2.1.1.7 replace part(s)

HA2.1.1.8 repair component

HA2.1.1.9 replace component

HA2.1.1.10 temporary repair

HA2.1.1.11 temporary by-pass

HA2.12 Modification/Redesign of component

HA2.1.3 Modification of operation duty (a)

HA2.1.4 Special surveillance (a)

HA2.1.5 Control of similar equipment

HA2.2 Administrative Consequences

HA2.2.1 On Repair Schedule

HA2.2.1.1. Urgent Repairs

- urgent repairs that may result from emergencies and are accomplished bypassing normal administrative procedures
- urgent repairs accomplished without bypassing normal administrative procedures

HA2.2.1.2 Not-urgent Repairs

- accomplished at a scheduled time
- accomplished at nearest shut-down

HA2.2.2 On Plant Operation

HA2.2.2.1 Forced stop required

HA2.2.2.2 Stop required at short term

- repair within 2 days
- repair within 7 days
- repair within 14 days
- repair within 30 days

HA2.2.2.3 No unscheduled unit shut-down required

HA2.2.2.4 Others

HA2.2.3 Documentation

HA2.2.3.1 - Failure reported to architect/engineer

HA2.2.3.2 - Failure reported to NSSS vendor

HA2.2.3.3 - Failure reported to consultant

HA2.2.3.4 - Failure reported to component manufacturer

HA2.2.3.5 - Failure analysis recommended

HA2.2.3.6 - Failure analysis performed

HA2.2.3.7 - Photographs were made

HA2.2.3.8 - LER submitted

HA2.2.3.9 - None of the above

HA2.3 <u>Start-up Restrictions</u>

HA2.3.1 - No restriction

HA2.3.2 - Permission by licensing authorities

HA2.3.3 - Request Licensee Revision

<u>Comments</u>

The ISPRA classification is adopted, see Mancini et al. 1979. It is identical with that used under the human factors category ACTIONS TAKEN: Other actions taken.

G	CONSEQUENCES OF THE EVENT
G1	Consequent effect on system as stated in category: SYSTEMS AND COMPONENTS AFFECTED
G1.1	System inappropriately put into operation
G1.2	Loss of system function
G1.3	Degraded system function
G1.4	Loss of redundancy:
G1.4.1	Loss of 1 train
G1.4.2	Loss of 2 trains
G1.4.3	Loss of 3 trains
G1.4.4	Loss of more than 3 trains
G1.5	No significant effect on system
G2	Consequent effect on reactor operation:
G2.1	No significant effect
G2.2	Delayed coupling
G2.3	Partial standstill or power reduction
G2.4	Turbine trip
G2.5	Reactor shut-down (automatic/manual trip, forced shut-down)
G2.6	Abnormal off-site releases
G2.7	Abnormal radiation level in working area

Comments

The purpose of this category is not to characterise the human malfunction but to indicate the efficiency of the various measures for stopping the propagation of the event chain initiated by the malfunction. The category is based upon that used by ISPRA with a few changes.

J	PERSONNEL IDENTIFICATION
J1	Utility management
J2	Plant management
J3	Shift supervisors
J4	Licensed operators or senior operators
J5	Non-licensed operations personnel
J6	Roving operators
J7	Maintenance and repair personnel:
J7.1	Mechanical profession
J7.1	Electrical profession
J7.2	Electronics profession
J7.4	Chemical profession
J7.5	Profession not specified
J8	Health physics personnel
J9	Design and fabrication personnel
J10	Construction personnel
J11	Contractor and consultant personnel
J12	Other foreign personnel
J13	Other not covered above
J14	Not stated

Comments

This category is intended to represent information on the educational background and organisational relation of the person. Implicitly it characterises the actual work situation of the person during the event.

K	PERSONNEL LOCATION
K1	Central control rooms
K2	Other control room consoles
K3	Relay and terminal rooms
K4	Work on equipment in plant under normal conditions
K5	Work on equipment in radiologically controlled areas
K6	Workshop
K7	Office
K8	Outdoor
K9	Other location
K10	Not stated, not applicable

Comments

This category represents a general characterisation of the work location during the occurrence of the malfunction.

L PERSONNEL TASK

L1 Design and design changes of equipment

L2 Procedure design and modification

L3 Fabrication

L4 Installation

L5 Inspection

L6 Operation:

L6.1 Monitoring

L6.2 Manual acts, maneuvers and other manual operations

L6.3 Inventory control

L6.4 Supervisory control

L7 Test and calibration:

L7.1 Getting access to location for work (including getting permit)

L7.2 Preparation of equipment and tools

L7.3 Execution of the actual test and calibration activity

L7.4 Restoration, removal of tools etc.

L8 Maintenance and repair (modification etc.):

L8.1 Getting access to location for work (including getting permit)

L8.2 Preparation of equipment and tools

L8.3 Execution of the actual maintenance activity

L8.4 Restoration, removal of tools etc.

L9 Logistics

L10 Administration: recording, reporting etc.

L11 Management: resource allocation and supervision

L12 Other not covered above

L13 Not stated, not applicable

Comments

The identification of the task is important to describe the circumstances during which the event occurred. Description of elements and structure of a task and correlation with data on HUMAN MALFUNCTION MECHANISMS and INTERNAL HUMAN MALFUNCTIONS are necessary to predict human performance in new or revised work situations.

The tasks of Test/Calibration and Maintenance/Repair are described rather detailed in the present taxonomy, because they were well represented in the sample on which the taxonomy has been based

and because they are immediately safety related.
Other safety related tasks e.g. inventory control and supervisory control should be considered for extended description in actual data collection campaigns.

M EXTERNAL MODE OF MALFUNCTION AS LEADING TO THE STATED CONSEQUENCES OF THE EVENT

M1 The specified or intended task not performed due to

M1.1 Omission of task

M1.2 Omission of act

M1.3 Inappropriate, inaccurate performance

M1.4 Inappropriate timing

M1.5 Actions in wrong sequence

M2 The effect is due to specific, erroneous acts on system under treatment:

M2.1 Wrong act executed on correct component, equipment

M2.2 Wrong component, equipment

M2.3 Wrong time

M3 The effect is due to extraneous act, i.e. act on other system than that under treatment

M4 The effect is due to coincidence or co-effect with other erroneous or normal human activity or technical condition. Sneakpath tied to special circumstances

M5 Not stated, not applicable

Comments

This category describes the immediate, observable external effect of human malfunction upon the task performance. It reflects the way in which the malfunction initiates the consequent chain of accidental events. This category and the correlation to categories INTERNAL HUMAN MALFUNCTION and MECHANISMS OF HUMAN MALFUNCTIONS, are important for prediction of the effect of human malfunction in a specific task and/or system.

In case of simple human malfunction, there is found a direct relation between these three categories and the structure of the task, in more complex situations involving a sequence of critical human decisions, this is not the case (see comment to INTERNAL HUMAN MALFUNCTION). Likewise, in some cases the effect cannot be predicted from a task analysis (extraneous acts). Therefore, special subcategories are given for extraneous acts and complex coincidences.

It is recommended that the content of the category EXTERNAL MODE OF MALFUNCTION is extended by future data collection campaigns for important safety related tasks as for instance repair and test/calibration. This can be done by extending the present category or, as it has been done in this taxonomy, by differentiating the description of the task. See the category PERSONNEL TASK.

N POTENTIAL FOR SELF-CORRECTION

N1 <u>Lack of correction by the performing person himself due to:</u>

N1.1 Malfunction not immediately observable

N1.2 Malfunction not immediately reversible

N2 <u>Not stated, not applicable</u>

<u>Comments</u>

Information on the detection of the malfunction is important, since it is tightly coupled to the initiation of an event report, and, therefore, may bias the data reported. For instance human malfunction which is immediately corrected will not release a report, and potential for operators' self-monitoring will be an important bias on the data.

A more elaborate description of the potential for self-correction will be important, but should be part of the background description of the task for which event data are collected, not a part of the event record. The present members of the category has been used to separate the two major bias factors during analysis of existing event compilations.

P	SITUATION FACTORS
P1	Task characteristics, "preparedness
P1.1	Familiar task on schedule
P1.2	Familiar task on demand
P1.3	Unfamiliar task on schedule
P1.4	Unfamiliar task on demand
P1.5	Other not covered above
P1.6	Not stated, not applicable
P2	Physical environment
P2.1	Noise
P2.2	Uncomfortable temperature, humidity, pressure, smell etc.
P2.3	Light
P2.4	Radiation
P2.5	Other not covered above
P2.6	Not stated, not applicable
P3	Work time characteristics
P3.1	Day shift
P3.2	Night shift
P3.3	In beginning of shift
P3.4	In middle of shift
P3.5	In end of shift
P3.6	Not stated, not applicable

Comments

Information on factors related to the general work situation which will modify performance and probability of human malfunction is important. In the present context, the categories SITUATION FACTORS and PERFORMANCE SHAPING FACTORS are used to describe the more general work conditions, such as noise, temperature, workload, etc., and other factors which are generally affecting the state of an operator and which are not tied to a causal relation among events and acts, but rather contributing an overall modification of the performance. Physiological and psychological factors related to individuals are not recommended for inclusion into an event reporting scheme.

Important SITUATION FACTORS are related to the "preparedness" of the operator for the specific event. The taxonomy in this respect includes a distinction between familiar and unfamiliar

task and between scheduled task and task on demand.
A familiar task is a task which is performed frequently enough to enable the person to perform it by know-how, i.e. without the need for special planning or modification of procedures.
An unfamiliar task is a task which needs special planning or consideration of modification of procedures or normal work practise, or is so infrequent that use of preplanned written instructions is needed.
On schedule refers to the situation when special procedures are planned ahead or existing procedures can be studied and rehearsed, or the task is initiated by the operator according to a time schedule.
On demand represents the situation when planning has to be done concurrently with task performance and typically is based on the operators diagnosis and immediate decisions, i.e. the task is called for unexpectedly by the system, e.g. interfering with an already running task.
The distinction between SITUATION FACTORS and PERFORMANCE SHAPING FACTORS is made only to separate the information which can be recorded immediately by check lists from information which depend on human factors analysis, respectively.
Guidelines for use of the subcategories under "Task characteristics" are presented in Pedersen et al. 1981.

HA	ACTIONS TAKEN
HA1	In order to improve human functions:
HA1.1	Reinforcement of instructions
HA1.2	Revision of procedures and instructions
HA1.3	Modification of equipment design
HA1.4	Modification of work planning
HA1.5	Modification of work situation
HA1.6	Modification of organisation
HA1.7	Retraining and rehearsal
HA1.8	Redesign of training program
HA1.9	Other not stated
HA2	Other actions taken:
HA2.1	**Corrective Action**
HA2.1.1	**Corrective maintenance**
HA2.1.1.1	**repair without disassembly**
HA2.1.1.2	**repair with partial disassembly**
HA2.1.1.3	**repair with total disassembly**
HA2.1.1.4	**recalibration, reseal, repack**
HA2.1.1.5	**adjust**
HA2.1.1.6	**repair part(s)**
HA2.1.1.7	**replace part(s)**
HA2.1.1.8	**repair component**
HA2.1.1.9	**replace component**
HA2.1.1.10	**temporary repair**
HA2.1.1.11	**temporary by-pass**
HA2.1.2	**Modification/Redesign of component**
HA2.1.3	**Modification of operation duty (a)**
HA2.1.4	**Special surveillance (a)**
HA2.1.5	**Control of similar equipment**
HA2.2	**Administrative Consequences**
HA2.2.1	**On Repair Schedule**
HA2.2.1.1	**Urgent Repairs** - **urgent repairs that may result from emergencies and are accomplished by-passing normal administrative procedures** - **urgent repairs accomplished without bypassing normal administrative procedures**
HA2.2.1.2	**Not-urgent Repairs** - **accomplished at a scheduled time** - **accomplished at nearest shut-down**

HA2.2.2 **On Plant Operation**

HA2.2.2.1 **Forced stop required**

HA2.2.2.2 **Stop required at short term**

- **repair within 2 days**
- **" " 7 "**
- **" " 14 "**
- **" " 30 "**

HA2.2.2.3 **No unscheduled unit shut-down required**

HA2.2.2.4 **Others**

HA2.2.3 **Documentation**

HA2.2.3.1 **- Failure reported to architect/engineer**

HA2.2.3.2 **- Failure reported to NSSS vendor**

HA2.2.3.3 **- Failure reported to consultant**

HA2.2.3.4 **- Failure reported to component manufacturer**

HA2.2.3.5 **- Failure analysis recommended**

HA2.2.3.6 **- Failure analysis performed**

HA2.2.3.7 **- Photographs were made**

HA2.2.3.8 **- LER submitted**

HA2.2.3.9 **- None of the above**

HA2.3 **Start-up Restrictions**

HA2.3.1 **- No restriction**

HA2.3.2 **- Permission by licensing authorities**

HA2.3.3 **- Request Licensee Revision**

Comments

This is a category describing the actions taken in order to remedy the malfunction.

The first subcategory covers actions particularly aiming at improving human functions, the second covers other actions and is identical with the ISPHA classification already given under HA COMPONENTS: ACTIONS TAKEN.

Q INTERNAL HUMAN MALFUNCTION

Beware: Internal human malfunction does not necessarily imply a failure or error on the part of the man.

Q1 Detection: Operator does not respond to a demand.

Q2 Identification of system state: Operator responds but misinterprets the system state.

Q3 Decision:

Q3.1 Selection of goal: Operator responds to properly identified system state, but aims at wrong goal (e.g. operation continuity instead of safety).

Q3.2 Selection of system target state: Operator selects an improper system target state to pursue proper goal (e.g. he decreases power to 80% instead of shut-down).

Q3.3 Selection of task: The operator selects a task, an activity which will not bring the plant to the intended target state.

Q4 Action:

Q4.1 Procedure: The sequence of actions performed is inappropriate or incorrectly coordinated for the task chosen.

Q4.2 Execution: The physical activity related to the steps in the procedure is incorrect.

Q4.3 Communication: Written or verbal messages are given incorrectly.

Q5 Not stated, not applicable

Comments

The operator's task which is specified in the category PERSONNEL TASK in terms referring to the operational requirements of the plant will require some internal, mental data processing or decision function.

The category INTERNAL HUMAN MALFUNCTION is a causality-ordered sequence of human decision elements and is used to characterise that step/element in the decision sequence which was inappropriately performed or not performed at all due to a habitual bypass.

There is basically some ambiguity in this classification:
Firstly, the description in terms of identification, decision

and execution can be done at several levels of detail in the task description. It is intended that the use in event classification should be kept at a high level referring to the overall task description. A repair task can be taken as example: the diagnostic part of this task: to find the fault, should, if incorrectly performed, be classified as "identification of system state".

Alternatively, assume that the diagnosis has been correctly performed, that the repair man's proper intention of component replacement has been stated, and that he is performing the actions necessary for the fault remedy. During this phase of activities the repair man performs actions in wrong order of succession, because he does not identify the real state of the system under repair: this should be classified as "procedure".

This is a matter of convention - but the position taken here can be defended, partly from the fact that information for classification at a very detailed level generally is not present in event reports, partly from the usefulness of the classification results for improvement of work aids.

Secondly, ambiguity is caused by the fact that malfunction in the first phases of a decision will frequently lead to inappropriate decisions later in the sequence. To describe such sequences, detailed time line analysis and identification of all critical decisions are necessary, as described by Pew et al (1981), but this analysis must be based on very careful data collection including interviews of personnel (which is only feasible if it can be done immediately after the event, for instance by studies on training simulators.)

In general, the information cannot be obtained and in the present taxonomy we suggest that classification is only done for the first element of the human decision sequence which is inappropriately performed or shunted out by stereotyped bypass. Since most event reports are backtracking the course of events to an explaining plausible cause, this first malfunction sending the operator off the proper track, is the most likely to be represented in the record. This means that in more complex situations, the causal relation from the internal human malfunction and the related error mechanisms to the external effect of the malfunction will not be preserved in the recorded data. However, from a view point of statistical quantification or generalization in terms of improvements, this is not too important in the present context since the variability and degrees of freedom in human responses after a wrong decision - say an identification - is so high that they can only be characterized after detailed studies.

It must be emphasized that the category INTERNAL HUMAN MALFUNCTION does not take into account any cause of the malfunction and that the term "malfunction" does not imply in itself a "human error".
The malfunction can be caused by external conditions or events, such as interfering people, wrong orders, ordered absence etc., which are all considered separately under CAUSES.

The members of the present category are derived from a model of human decision sequence which is described in detail in Rasmussen (1974) and which has been used to derive the guidelines for analysis presented in Pedersen et al. 1981. For reference the model is illustrated in Figure 3.

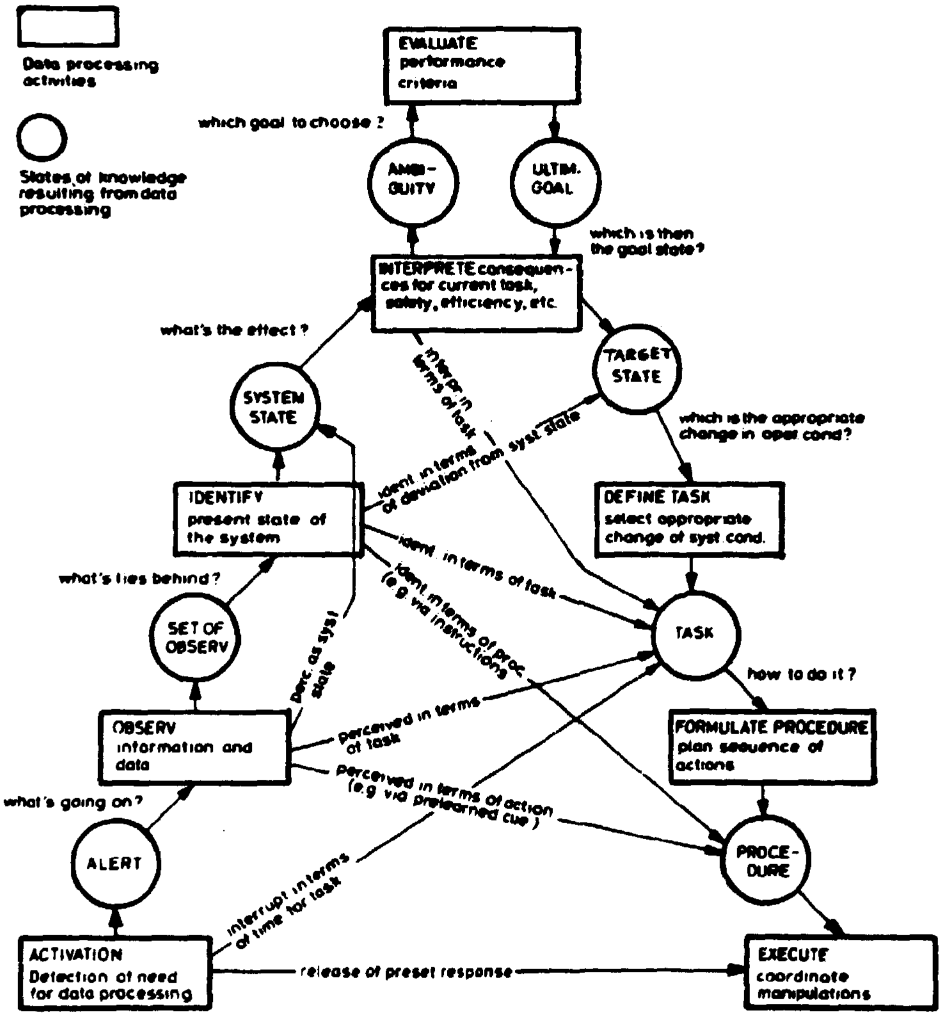

Figure 3. Model of human decision sequence. Reproduced from Rasmussen, 1976.

R	CAUSES OF HUMAN MALFUNCTION
	Event or short term condition taking active part as a link in the causal chain of events
R1	<u>External events</u>:
R1.1	Distraction by system and/or environment
R1.2	Distraction by other persons: Questions, message, noise
R2	<u>Excessive task demand in the specific situation</u>:
R2.1	Physical demand, time, force, etc.
R2.2	State information inadequate, wrong
R2.3	Background information related to the specific situation (knowledge, instruction) inadequate or wrong
R3	<u>Operator incapacitated</u>: (sick, injured, etc.)
R4	<u>No external cause</u>:
R4.1	Intrinsic normal human variability; spontaneous human error
R4.2	Intentional act
R4.3	Sabotage
R5	<u>Other not stated above</u>
R6	<u>Not stated, not applicable</u>

<u>Comments</u>

Identification of possible external causes is important for many reasons. First of all, there is a natural tendency when analysing the chain of events implied in maloperation of a system to accept a human error as the explanation if an inappropriate human act is met by the causal backtracking; the tendency is natural since it is difficult to continue the causal backtracking "through" a human performance, and also it is generally accepted that it is "human to err". It is, therefore, important that special care is taken to identify possible external causes as part of an event analysis.

Common sense definition of causes is very ambiguous and, therefore, in the present context must be clarified. From a point of view of quantification of human error it is beneficial if the definition of cause is clearly related to the frequency of the events analysed. Therefore, we define as a cause an event or a change in the man's normal work condition which acts as a causal precedent to his inappropriate action. General conditions

which may affect his error proneness such as normal, but high noise level, inappropriate ergonomic design, fatigue during night shifts etc., are all considered SITUATION FACTORS or PERFORMANCE SHAPING FACTORS which influence the error probability, but - according to our definition - does not cause errors.
The present members of the category "causes" should be taken as illustrative; they are based on a limited number of analyses, generally reliable information on causes is not to be found in event reports due to the reasons discussed above. Special guidelines for identification of causes as part of event analysis will be developed within the present CSNI work, based on the analysis published by Griffon (1981).
More general guidelines for use of the category R: CAUSES OF HUMAN MALFUNCTION are presented in Pedersen et al. 1981.

S MECHANISMS OF HUMAN MALFUNCTION

S1 Discrimination

This group is related to the man's ability to discriminate between and select the proper mode of control of his activities. The subcategories of malfunction mechanisms are characterized by interference between the man's repertoire of stereotyped habitual - and often subconscious - responses on one side and on the other side aspects of the actual work situation during infrequent and unique task demands.

S1.1 Stereotype (skill) fixation

Definition: Man operates in skill-based domain. He does not recognize a situation calling for attention and caution.
(Cues for recognition may not be present or may be overlooked, this is characterized by the categories: CAUSE OF HUMAN MALFUNCTION, or INTERNAL HUMAN MALFUNCTION)

S1.2 Familiar association short-cut

Definition: It is recognized that conscious identification of the situation is needed but familiar cues activate incorrect intention and task in man. It is not recognized that knowledge based evaluation and planning is needed.

S1.3 Stereotype take-over

Definition: Task or act according to proper intention, but "absentmindedness" during performance leads to relapse to stereotype action links related to different act or task.

S1.4 Lack of recognition of familiar pattern

Definition: Familiar pattern relevant for the situation is not recognised, higher level knowledge--based evaluation or planning is unnecessarily and inappropriately applied.

S2 Input information processing

The subcategories are related to the man's activities in obtaining information.
That an information output malfunction has occurred is classified under:

INTERNAL HUMAN MALFUNCTION

Erroneous function in action

Communication given incorrectly

S2.1 <u>Information not recieved/sought</u>

Definition: Cues do not activate man because sensitivity/attention is insufficient for present information level.

S2.2 <u>Misinterpretation of information</u>

Definition: Response is based on wrong apprehension of information such as misreading of text or instrument, misunderstanding of verbal message.

S2.3 <u>Assumptions replace search for information</u>

Definition: Response is inappropriately based on information supplied by the operator (by recall, guesses, etc.) which does not correspond with information available from outside.

S3 <u>Recall</u>

S3.1 <u>Forgetting isolated act or function</u>

Definition: Operator forgets to perform an isolated act or function, i.e., an act or function which is not cued by the functional context or is not having immediate effect upon the mental or motor sequence.

S3.2 <u>Mistake among alternatives</u>

Definition: Simple choice of wrong alternative, a category is correctly used but by wrong member, e.g., mistakes of up/down, +/-, left/right, A/B, open/closed, locked/unlocked.

S3.3 <u>Other slips of memory</u>

Definition: Erroneous recall of reference data values; names, item; need for actions, etc.

<u>Inferences</u>

This group is covering problems of linear thought in causal nets.

S4 <u>Side effects or latent conditions not adequately considered</u>

Definition: The man is in a less familiar situation characterized by knowledge-based, goal-controlled performance. He performs erroneously during functional inferences: The situation is not properly identified, the consequences of an event chain are not adequately predicted or an improper intention is chosen or latent conditions are not adequately considered. Consequently, the task or the intended goal is not fulfilled or adverse side effects occur or a combination of these consequences. (Can be due to oversight, lack of knowledge etc., this is characterized by the category: CAUSE OF HUMAN MALFUNCTION.

S5 Physical coordination

S5.1 Motor variability

Definition: Lack of manual precision, too big/small force applied, inappropriate timing. Including deviations from "good craftsmanship".

S5.2 Topographic, spatial orientation inadequate

Definition: In spite of man's correct intention and his correct recall of identification marks, tagging etc., he unawaringly performs task/act in the wrong place or on the wrong object, because he is following his immediate sense of locality, this, however, not being applicable (not updated, surviving imprints of old habits etc.).

S6 Other identified mechanisms

S7 Mechanism not identified

Comments

This category represents an attempt to formulate a set of generic, task independent human error mechanisms. The related categories EXTERNAL MODE OF MALFUNCTION and INTERNAL HUMAN MALFUNCTION are tightly task related and reflect basically the effect of inappropriate human performance upon the task. To evaluate human performance during design of new tasks and improved work conditions, including man-machine interfaces, it is important to identify human malfunction mechanisms in generic terms relating inappropriate task performance to features of the psychological mechanisms which are the basis of the performance and to limiting properties of such mechanisms.

A human is capable of performing the same task in various different ways depending upon the state of training, the subjective formulation of the goals and performance criteria, and consequently the role of the psychological mechanisms will be very person and situation dependent. Inappropriate task performance reflects a mismatch between task requirements and the human resources applied, and if the nature of this mismatch can be identified - irrespectively of the underlying cause - important information on the psychological mechanism applied and its limiting properties with respect to the task can be obtained.

The present category is intended to characterize cases of such resource/demand mismatch and is based on a model of operator performance derived from a preliminary analysis of 200 event reports (Rasmussen 1980). The structure of the model is illustrated in figure 4.

Guidelines for use of the category S: MECHANISMS OF HUMAN MALFUNCTIONS are presented in Pedersen et al 1981.

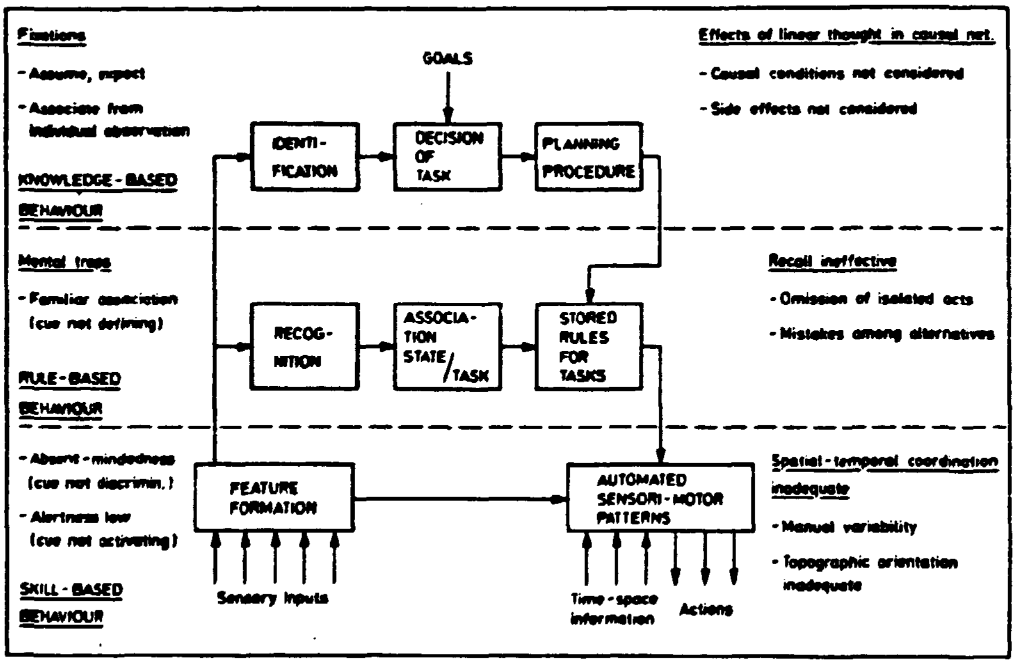

Figure 4. Model of human data processes and typical malfunctions. Reproduced from Rasmussen, 1980.

T	PERFORMANCE SHAPING FACTORS
T1	<u>Subjective goals and intentions</u>:
T1.1	Aspects of task performance are given exaggerated promotion e.g., speed, thoroughness, accuracy, effort to avoid delay
T1.2	Task content is inappropriately extended
T1.3	Task perceived as secondary
T1.4	Conflicting goals
T1.5	Other not covered above
T1.6	Subcategory not applicable
T2	<u>Mental load, resources</u>:
T2.1	Inadequate ergonomic design of work place
T2.2	Overlapping tasks
T2.3	Inadequate general education
T2.4	Inadequate general task training and instruction
T2.5	Other not covered above
T2.6	Subcategory not applicable
T3	<u>Affective factors</u>:
T3.1	Social factors
T3.2	Insufficient load, boredom
T3.3	Time pressure
T3.4	Fear of failure
T3.5	Other not covered above
T3.6	Subcategory not applicable

<u>Comments</u>

See comments to SITUATION FACTORS.
Guidelines for identifying performance shaping factors will be developed, based on the analysis in Griffon (1981).
Guidelines for use of the subcategories under "Mental load, resources" are presented in Pedersen et al 1981.

DATA COLLECTION FORMATS

Preprinted forms for data collection in plant and examples of their use are presented in the document SINDOC(81)15.

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Classification System for Reporting Events Involving Human Malfunctions

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Electronics

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Abstract

The report describes a set of categories for reporting industrial incidents and events involving human malfunction. The classification system aims at ensuring information adequate for improvement of human work situations and man-machine interface systems and for attempts to quantify "human error" rates.

The classification system has a multifacetted non-hierarchical structure and its compatibility with Ispra's ERDS classification is described. The collection of the information in general and for quantification purposes are discussed. 24 categories, 12 of which being human factors oriented, are listed with their respective subcategories, and comments are given.

Underlying models of human data processes and their typical malfunctions and of a human decision sequence are described.

7 references.

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