



Overview of the Integrated Human Event Analysis System (IDHEAS)

to

IAEA Technical Meeting

On Development of the Safety Report on HRA for Nuclear Installations

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NRC's Human Reliability Analysis (HRA) Research Activities

Scientific foundation:
Cognitive Basis for HRA

“Building a Psychological Foundation for HRA”
NUREG -2114 (2016)

HRA data:
SACADA and others

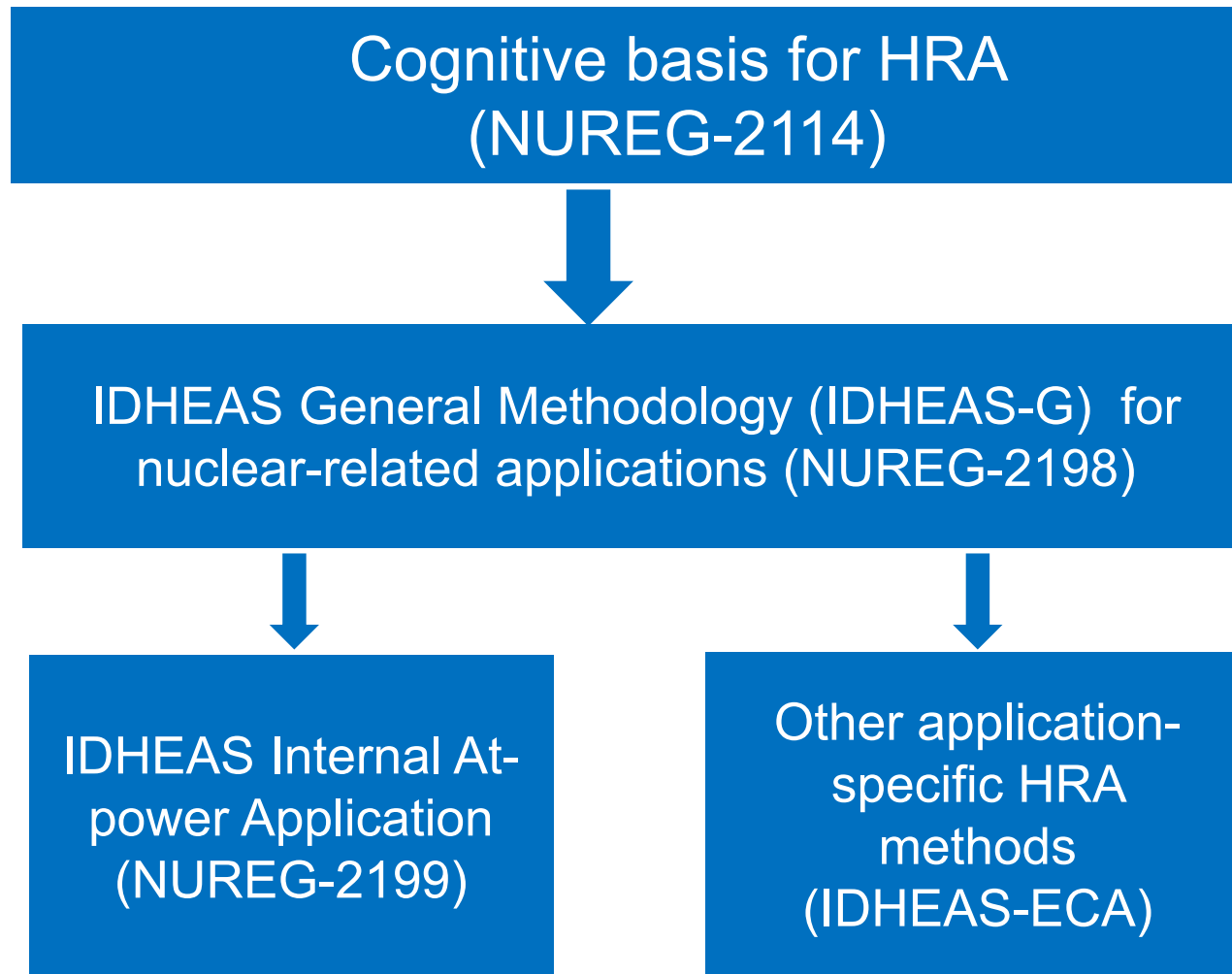
HRA method improvement:
IDHEAS

NUREG-2199,

- Vol.1 - IDHEAS At-Power method (2016)
- Vol.2 - Expert elicitation of HEPs
- Vol.3 - Testing the method
- Vol.4 - Users' manual

NUREG-2198 - IDHEAS General Methodology (draft)

HRA method improvement – Development of IDHEAS (Integrated Human Event Analysis System)

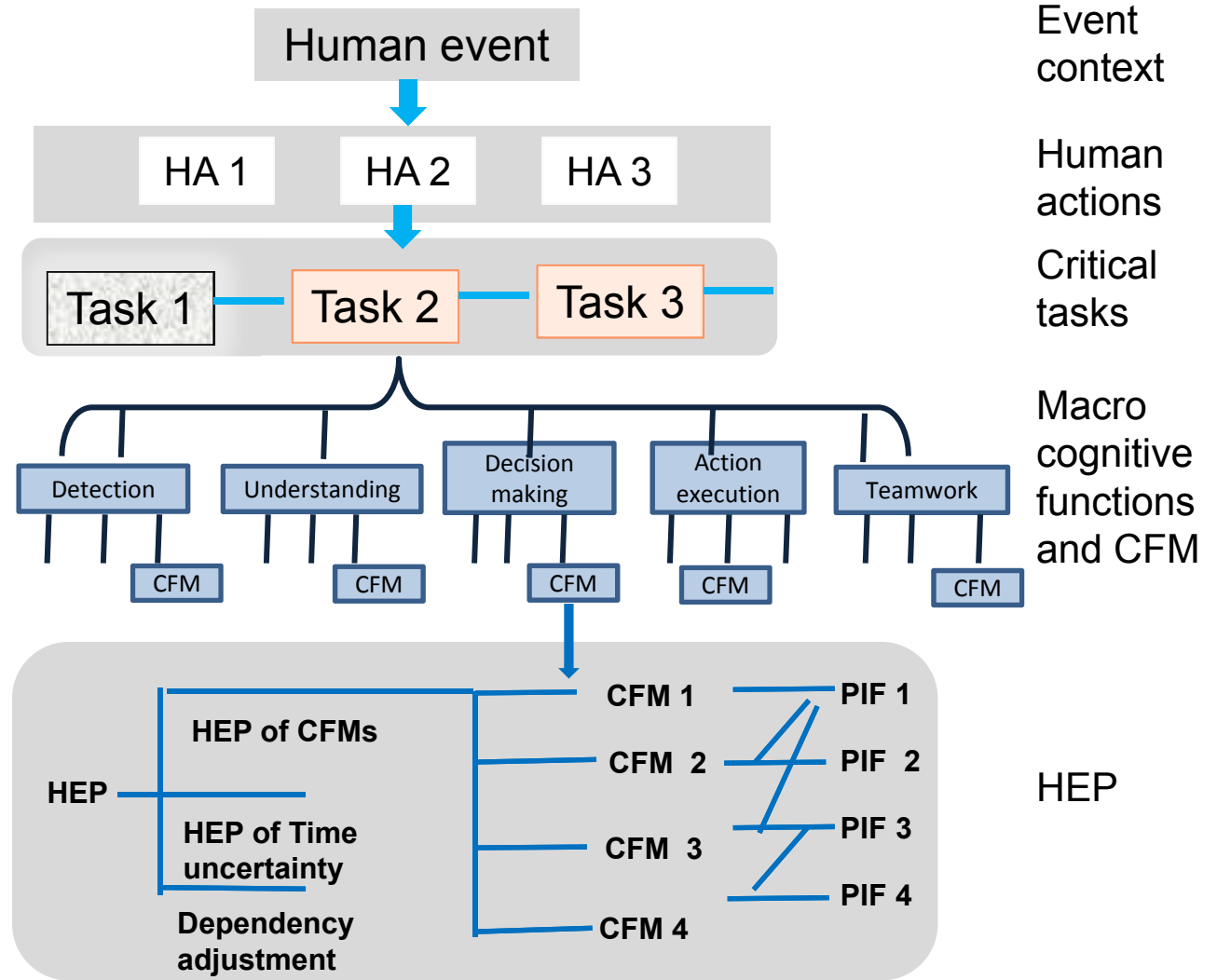


IDHEAS Key Features

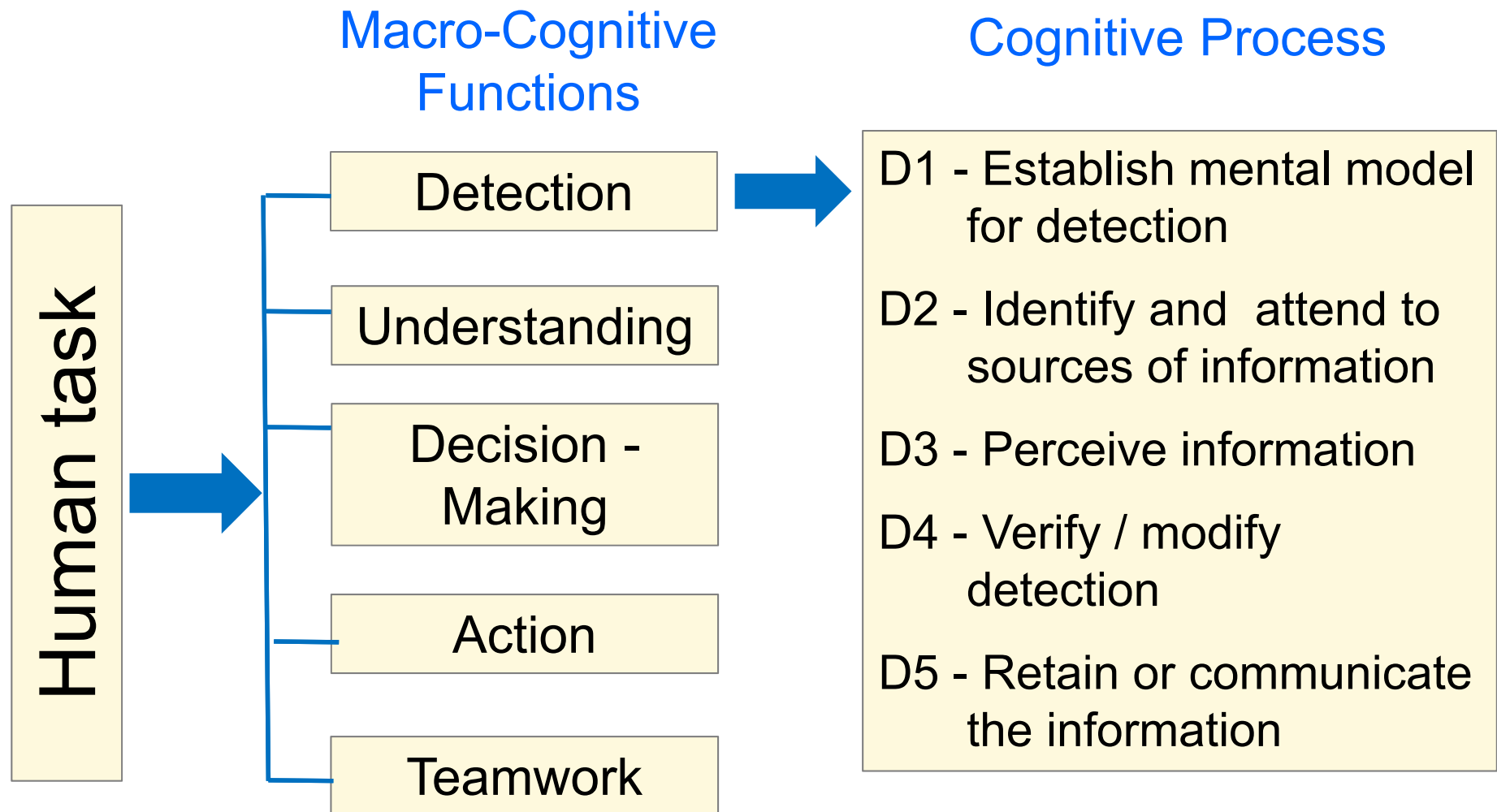
- General methodology – IDHEAS models the full cycle of cognitive process underlying human actions and it is application-independent
- Systematic approach and explicit guidance for qualitative analysis - Scenario and context analysis, human failure event (HFE) identification, task analysis
- Basic quantification structure
 - Including a basic set of cognitive failure modes (CFMs), a comprehensive list of performance influencing factors (PIFs), and guidance for estimating HEPs;
 - Application-specific quantification models can be derived from the Basic Quantification Structure
- Built-in interface with human error data – same structure with SACADA database

Overview of IDHEAS Process

- Analyze scenario context
- Identify risk-important human actions
- Analyze tasks and identify critical tasks
- Analyze Time uncertainty
- Analyze cognition failure:
 - Identify cognitive failure modes (CFMs)
 - Assess performance influencing factors (PIFs)
 - Estimate human error probabilities (HEPs)
- Adjust HEP based on Dependency
- Analyze uncertainties



IDHEAS-G Is Based on Cognitive and Behavioral Science



Basic Set of CFMs in IDHEAS Quantification Structure

Failure of Macro-Cognitive Function

- Failure of Detection
- Failure of Understanding
- Failure of Decisionmaking
- Failure of Action Execution
- Failure of Teamwork



Failures of Cognitive Processes (Proximate causes)

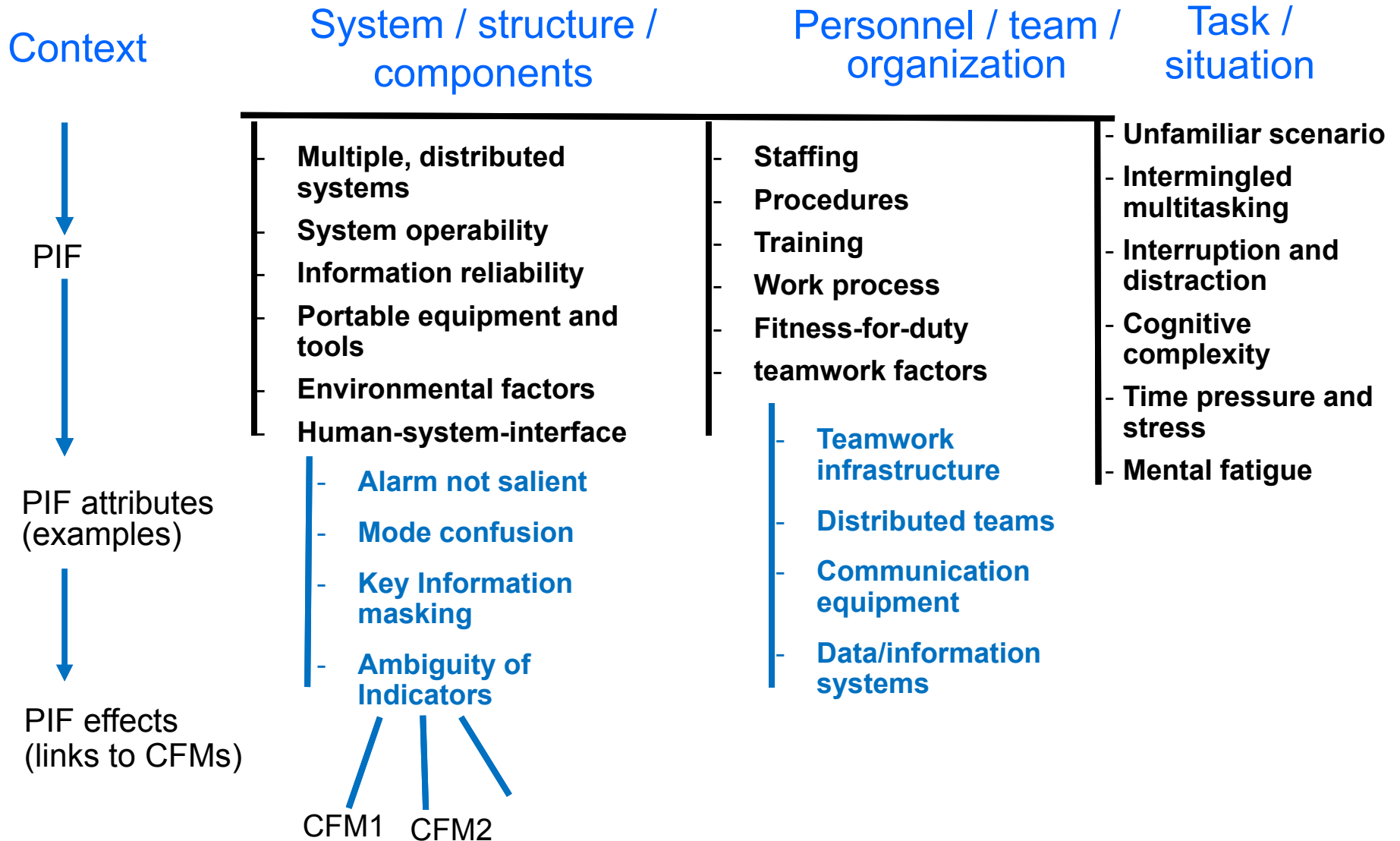
- D1- Fail to establish acceptance-criteria
- D2 – Fail to attend to sources of information
- D-3 – Fail to perceive the information
- D4- Fail to verify and modify detection
- D5- Fail to retain or communicate Information



Behaviorally Observable Attributes

- D3-1 Primary information is not available
- D3-2 Key alarm or alert not attended to
- D3-3 Key information not perceived
- D3-3 Information misperceived (e.g., failing to discriminate signals, reading errors)
- D3-5 Parameters incorrectly monitored

IDHEAS-G PIF Structure



Summary of IDHEAS Generic Methodology

- Based on the Cognitive Basis for HRA (NUREG-2114)
- Expanded scope to address:
 - Broad spectrum of human actions
 - Coordination and cooperation among multiple entities
 - Complicated decision-making
 - Performance influencing factors in severe conditions (e.g., radiation)
- Tailorable to broad applications such as:
 - Level 2 and 3 PRA
 - Reactor shutdown operations
 - External events
 - Fuels, materials, by-product