HUNTER: A Digital Operator for Risk Analysis

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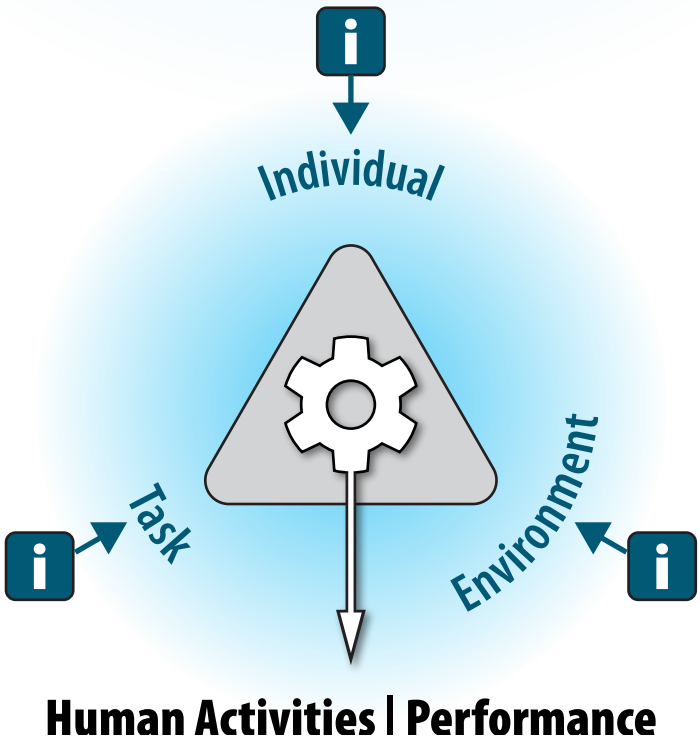
Risk-Informed Systems Analysis Pathway

Human reliability analysis (HRA) is the study of human error. HRA is integrated into probabilistic risk assessment (PRA) models at nuclear power plants to consider potential challenges to plant operations. Because plants have multiple levels of defense in depth—from human second checkers to engineered safety systems—the opportunity for an unintended human action to have a significant negative consequence on plant safety is minimal. PRA and HRA together ensure that all hardware and human risks are mitigated during operations.

Since the first HRA method—the Technique for Human Error Rate Prediction (THERP) [1]—HRA methods have been worksheet based. Scenarios of human activities are analyzed, and human error probabilities are calculated using lookup tables and simple quantification approaches. Dozens of HRA methods exist, each tailored to different applications. Many of these techniques have been incorporated into software tools like the widely used Electric Power Research Institute (EPRI) HRA Calculator [2].

Figure 14. Conceptual framework for HUNTER.



The Risk-Informed Systems Analysis (RISA) Pathway within the Light Water Reactor Sustainability (LWRS) program is developing new tools to support industry needs for advanced risk analysis. A new generation of computation-based risk analysis tools draws on advances in simulation to enable more comprehensive risk modeling than has been possible in the past. There are emerging areas of risk analysis not yet fully covered in HRA. For example, plant upgrades like control room modernization introduce new digital instrumentation and control technology. New technologies lack operating experience needed to inform traditional HRA methods.

Human Unimodel for Nuclear Technology to Enhance Reliability (HUNTER) was developed under the LWRS Program as an easy-to-use computation based HRA modeling framework to allow enhanced HRA capabilities for plants. It provides the ability to create a digital human model to be used in simulations of plant scenarios. These scenarios can be executed in a repeated Monte Carlo fashion, allowing what-if modeling for novel contexts. For example, the range of human activities involved in deploying FLEX equipment under a variety of situations could be simulated automatically using HUNTER. A similar effort using conventional HRA methods would typically require extensive manual analyses, proving labor and time intensive.

In March 2022, researchers in RISA published the first software release of HUNTER [3]. The HUNTER software features a first-of-a-kind graphical user interface to simplify model development. HUNTER integrates three core modules—task, environment, and individual (see Figure 14) into a simple-to-use interface (see Figure 15).

- The *task* module is based on plant operating procedures. The procedures specify the interface between the plant and operator, coordinating

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Figure 15. HUNTER procedure editor.