

**NRC Interest in the Effects of Human Factors and Training on Nondestructive Examination Reliability**

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**Human Factors, the Nuclear Industry, and NDE**



Motivation:  
Nondestructive examination in the field have different results than the results in qualification tests

There have been international efforts to look into human factors in the past  
Efforts on Human Factors gave focused on control room design and similar areas, NDE has received less attention

Improvements may be realized by putting the NDE and Human factors experts in a coordinated research program

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**Human Performance Issues in Recent Operating Experience**



There have been recent examples of flaws missed in the field

- Pressurizer overlay welds
- Control rod drive nozzle



Human factors may have played a part in the missed flaws in several missed flaws in a 2012 inspection



The NRC staff believes human factors improvements may improve inspections

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**Previous NRC Work on Human Factors in NDE**

NUREG/CR-4436 from 1986 is a feasibility study on NDE

NUREG/CR-4600 from 1986 describes the results of a mini-round robin

NUREG/CR 6605 from 1998 describes the PISC III Human Factors Results



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**Recommendations from 1986 Work**

NUREG 4436 recommended a detailed Human Factors research program

- Conduct on-site field evaluations of actual inservice inspections
- Evaluate and characterize the cognitive aspects of the flaw detection
- Compare technician training and perceptions with actual performance
- Conduct experiments to measure and evaluate key human performance factors

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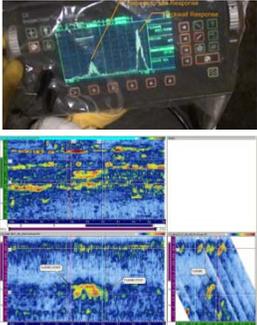
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**Flaw Detector Evolution**

1980's



2010's



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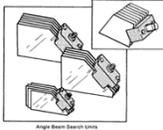
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**Manual Search Unit Evolution**



While the piezocomposites are superior to older piezoceramics, the external designs have changed little

1980's



2010's



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**Planned NRC Human Factors Research**



A cooperative program is being developed at the NRC

The research will focus on manual and encoded UT examinations

Task 1 is a literature review to collect existing human factors knowledge that can be applied to NDE

Task 2 will be a comparative task analysis that explores the differences between laboratory testing and field examinations

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**Research Goals**



Evaluate the human factors issues facing NDE inspectors

Determine the differences between qualification testing and field inspections

Determine the highest priority Human Factors issues that could be degrading NDE performance in the field

- Equipment
- Procedures
- Conditions

Develop a testing program to analyze the effects of these factors

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**Task 1 – Literature Review**



Identify and survey the body of knowledge and apply to NDE issues

- A job task analysis of UT examinations
- The effects of fatigue on performance
- How long a signal must be visible
- Time required for an analyst to review recorded data
- Effects of practice on inspector performance

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**Task 2- Comparative Task Analysis**



Examining the differences between laboratory scanning of vs. field inspections

Involves detailed observations of performance demonstration testing and field examinations

Systematically evaluate the qualification and inspection processes

Industry participation and partnership with EPRI

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**Substituting Laboratory Practice for Experience Hours**



Help the NRC staff evaluate Code Cases and proposed training programs

Laboratory experience could be very useful in training and qualifications

- No current basis for substituting training for experience hours

Task 2 will provide the Industry and the NRC with information on the differences between laboratory practice vs. field experience

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**Summary**



There is an apparent difference between the qualification tests and field inspections

The causes of this are not well understood

Previous efforts to determine the causes have produced mixed results

There is a body of knowledge on human factors that has not yet been applied to NDE

The NRC is evaluating the NDE process and comparing laboratory and field inspections

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