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Optimization of UT Techniques for Flaw Evaluation

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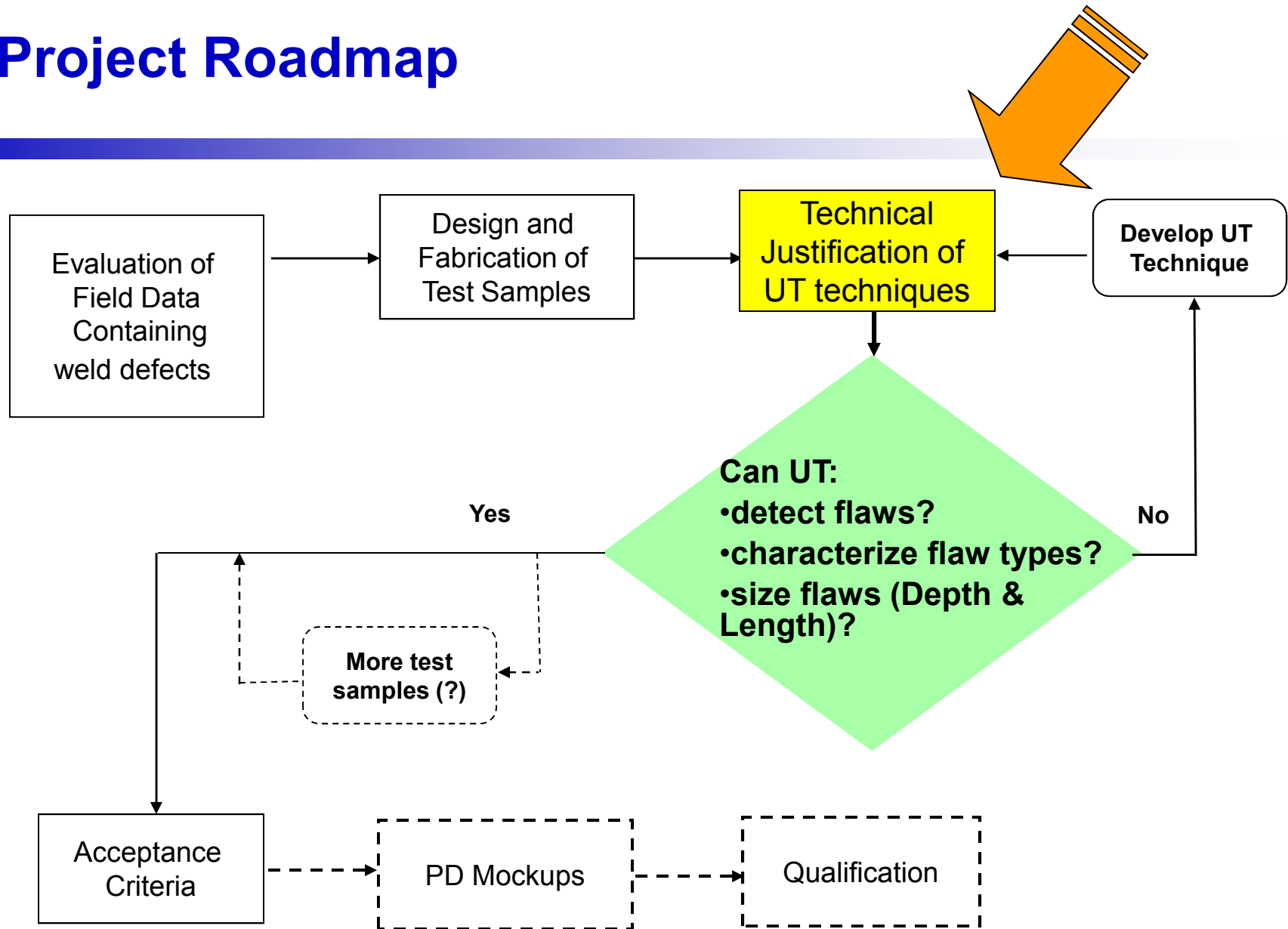
NRC Information Meeting
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Optimization of UT Techniques for Flaw Evaluations

- As welds are examined for the first time (existing and newly installed welds) using qualified procedures, examiners are detecting fabrication flaws that hadn't been detected before
  - In both cases this can lead to repairs or replacements that are not structurally necessary
- Several new projects were initiated to assist examiners in making this discrimination
  - NDEC project combined with Advance Nuclear Technology (ANT) project
    - Manufacture piping samples containing both fabrication and in-service defects
    - Develop techniques for discriminating between the two
    - This information also will be useful in construction examinations of new plants

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Project Plan and Delivery

- Project Plan
    - Develop an ultrasonic data analysis guideline for discriminating between service induced flaws and fabrication defects for piping applications
    - Assemble actual scanning surface conditions and ultrasonic field data with real flaws identified from inspections
    - Design and procure piping samples containing both pre-service and in-service defects
- Deliverables & Application Plan
    - Piping specimens which contain both pre-service and in-service defects
    - A guideline to assist in the analysis of ultrasonic data for piping applications
    - Initiate and support changes to ASME Section III acceptance criteria
        - Allow flaw dimensioning similar to Section XI IWB-3500

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Project Roadmap


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│  Evaluation of   │ ───> │   Design and     │ ───> ║   Technical      ║ <─── │   Develop UT     │
│   Field Data     │      │  Fabrication of  │      ║  Justification of║      │   Technique      │
│   Containing     │      │   Test Samples   │      ║  UT techniques   ║      │                  │
│   weld defects   │      │                  │      ║                  ║      │                  │
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Yes

No

Can UT:
- **detect flaws?**
- **characterize flaw types?**
- **size flaws (Depth & Length)?**

More test samples (?)

Acceptance Criteria → PD Mockups → Qualification

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Flow chart: Characterization & Classification of weld defects (Current Section XI approach and proposed Section III approach)

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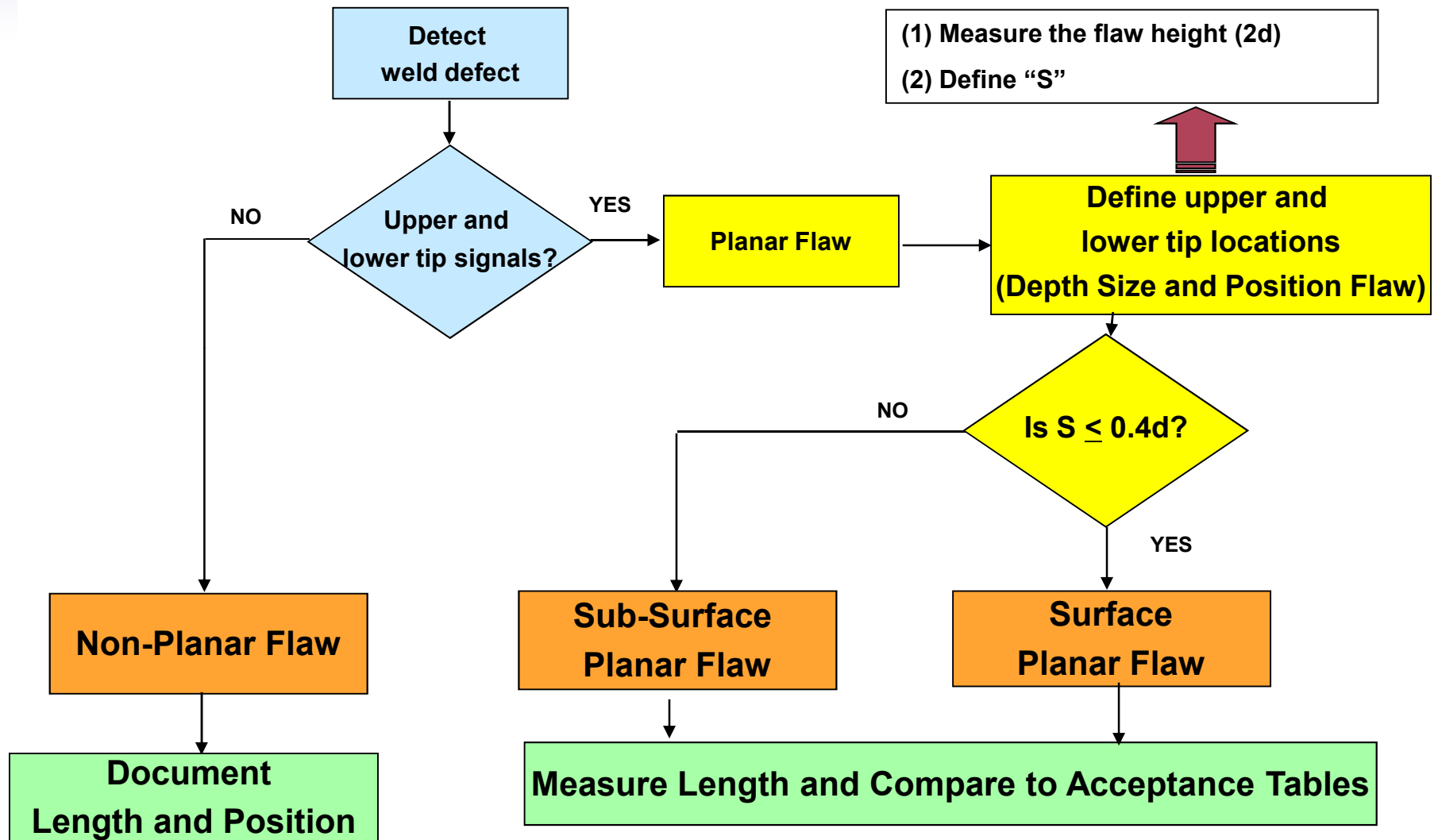
Project Status

- **A total of 65 weld defects were designed and installed in 15 test samples**

- **Distribution of weld defects**
  - **Flaw classifications**
    - **Surface Flaws - 8**
    - **SubSurface Flaw - 57**
  - **Flaw types**
    - **Planar Flaws - 35**
    - **Non-Planar Flaws - 30**

    Note: *: Non-Planar flaws: Slag, Porosity, Lack of bond, Incomplete penetration

Automated UT scanning

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Project Status

- Preliminary results
  - All test samples were examined
    - 98.5% of flaws were detected
    - 95.4% were correctly classified (surface vs sub-surface flaws)
    - 90.7% were correctly characterized as planar vs non-planar flaws
    - Depth RMSE: 0.093" (only planar flaws were sized)
    - Length RMSE: 0.346"

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Project Status

- Proposed Section III Code case has been presented
    - Included NDE results as part of technical basis
- Guidance on the proper evaluation of embedded flaws in being added to generic procedures and other industry procedures
- Technique development and refinement will continue
- Additional samples being evaluated

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Optimization of UT Inspections for Piping Applications

- Summary
  - Piping samples containing both fabrication and in-service defects will be manufactured
  - A guideline which includes an improved methodology for UT data analysis will be published
  - This project will result in more reliable piping inspections and limit the number of unnecessary component replacements and repairs due to misinterpretation of the ultrasonic data
  - Support changes to Section III acceptance criteria

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