Construction Experience
Concrete Quality Issues

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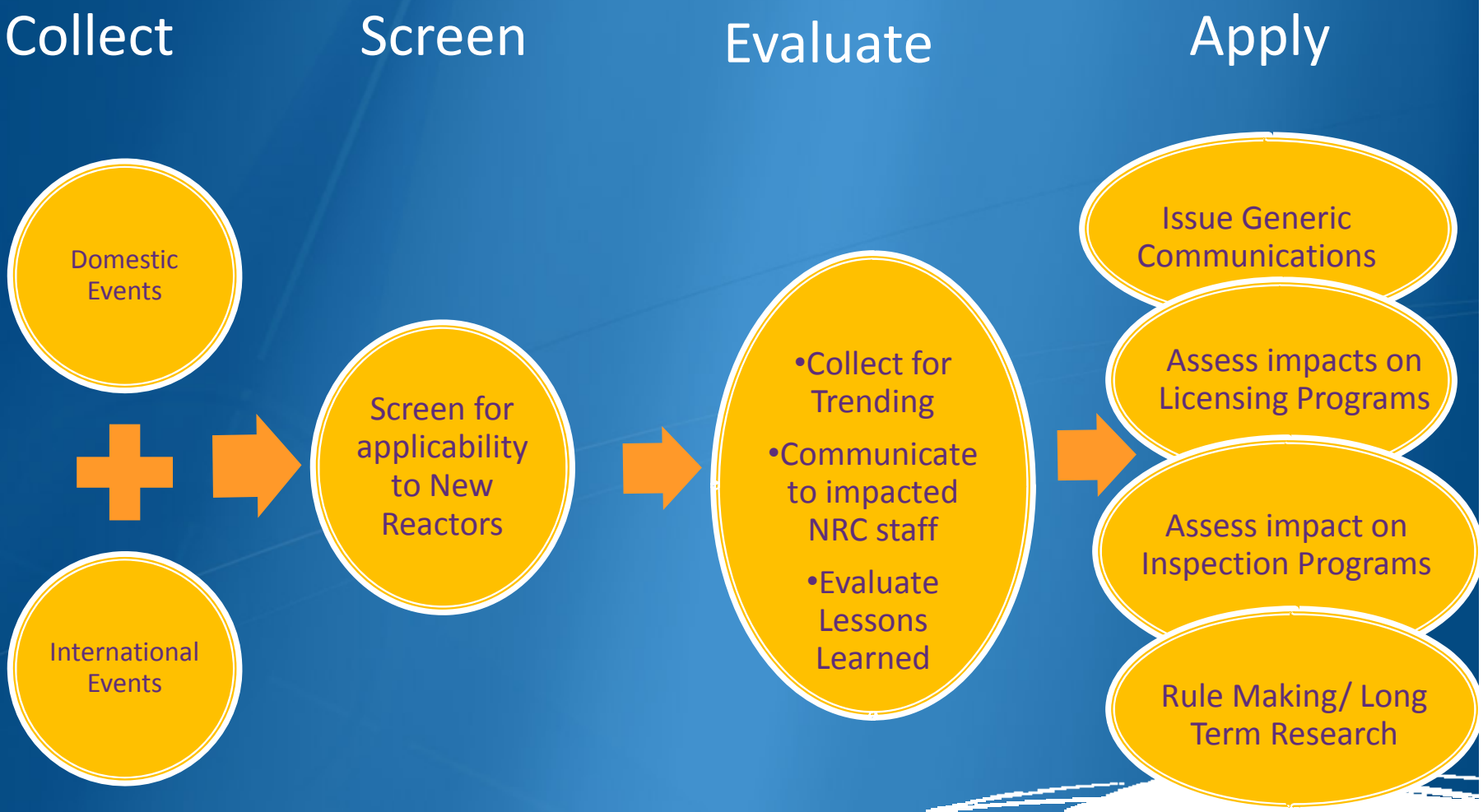
The US NRC Construction Experience Process



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Introduction

- Construction of nuclear installations include significant concrete activities.
- Review of domestic and international experience suggests that concrete quality is still an issue.

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Safety Functions of Concrete Structures

Include:

- Pressure retaining / containment / shielding;
- Housing of structures, systems and components (SSCs);
- Structural support for SSCs;
- Protection of SSCs from natural disasters such as earthquakes, tornadoes and hurricanes;
- Protection of SSCs from internally and externally generated missiles;
- Separation and protection of redundant SSCs from the effects of single failures.

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Safety Significance of Concrete Failures

Varies based on several factors such as:

- The functions of the impacted structure and the associated SSCs;
- The type of defect;
- The time of discovery : more significant for catastrophic self revealing failures; less significant for slow and progressive failures detected as part of normal monitoring;
- The design margin;
- The corrective actions planned or taken.

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Causes of Concrete Failures

Include:

- Latent design defects due to inadequate structural design, improper waterproofing, inattention to details and improper design changes;
- Latent construction defects caused by poor practices and negligence;
- Improper or inadequate maintenance;
- Environmental stressors;
- Beyond design bases accidents.

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Related NRC Publications

- NUREG-1055 covers among other things, historical concrete issues;
- NUREG/CR-6927 focuses on concrete degradation mechanisms and includes a comprehensive list of previous concrete problems at various operating nuclear plants;
- IN 2008-17 lists recent concrete issues at nuclear facilities both domestic and international;
- IN 2011-20 discusses concrete degradation by Alkali-silica Reaction.

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Issues Under Review

- Alkali-Silica Reaction (ASR) at Seabrook.
- Containment Delamination at Crystal River
- Shield Building Cracking at Davis-Besse

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Alkali-Silica Reaction (ASR)

- Seabrook identified ASR in Control Building/Electrical Building (and below-grade structures) in summer of 2009 during license renewal walkdowns;
- Standards used for testing during original construction may not accurately predict ASR. Additional tests (ASTM 1260 and 1293) are now recommended;
- ASR was also discovered in nuclear plants in Japan and Canada.

Other Issues Under Review

- On October 6, 2009 and again on March 15, 2011, the concrete containment at Crystal River 3 delaminated.
- On October 10, 2011, Davis-Besse discovered cracks in the Shield Building wall.

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Presentation Summary

- The NRC has issued many publications that address the prevention or minimization of concrete issues;
- Combined License (COL) applicants/holders should evaluate the available operating and construction experience to prevent similar problems;
- The staff continues to monitor and evaluate new developments for additional lessons learned.

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NRC Planned Actions

- Use ConE insights to inform concrete inspections using Inspection Procedures IP-65001.01, “Inspection of ITAAC-Related Foundations & Buildings”, IP-65001.02, “Inspection of ITAAC-Related Installation of Structural Concrete” and IP-35007, Quality Assurance Program Implementation During Construction and Pre-Construction Activities;
- Update NRC guidance documents to incorporate lessons learned as needed;
- Communicate lessons learned publically via issuing generic communications.

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References

- NUREG-1055, “Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants” covers among other things, historical concrete issues. See ML063000293;
- NUREG/CR-6927, “Primer on Durability of Nuclear Power Plant Reinforced Concrete Structures - A Review of Pertinent Factors”. See ML070850183;
- IN 2008-17, “Construction Experience with Concrete Placement”. See ML081850581;
- IN 2011-20; “Concrete Degradation By Alkali-silica Reaction”. See ML112241029;

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QUESTIONS?FEEDBACK

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