Dar Al Riyadh Insight #86
Design Reviews

Dar Al Riyadh Insights reflect the knowledge and experience of our Board, executives and staff in leading and providing PMC, design and construction management services. Dar Al Riyadh believes in the importance of broadly sharing knowledge with our clients and staff to improve project outcomes for the benefit of the Kingdom of Saudi Arabia.

Design Reviews

Design reviews and associated checking are performed by experienced engineers other than those who produce the design documents. Design reviews are often underpinned by robust checklists, which help to confirm that:

- The basis of design is comprehensively addressed. This is particularly important when an expanded basis of design has been developed.
- Assumptions have been carefully made, defined, and are appropriate for their intended use. Sensitivity to small changes in assumptions are noted and those to be more closely tracked as the design evolves are highlighted.
- Inputs and criteria are properly selected and used.
- All requirements, both those of the owner and regulator, are met.
- The various engineering disciplines have been fully integrated.
- Resulting design is complete and correct.
- Appropriate design margins have been achieved.

Engineering and design documents may be reviewed and checked individually or the review may be performed on a design package, e.g., for a system, plant area, or design task.

Design documents typically examined at each review point include:

- *System descriptions and design criteria documents*
  - Reviewed to confirm the expanded basis of design (encompassing technical, construction, and O&M

requirements) has been fully considered and addressed/reviewed.
  - Confirm that the use of applicable industry codes and standards is complete and correct (including interpretation).
  - Technology selection and decisions are well supported.

  - Conceptual design is technically correct.
  - Interfaces well defined and controlled; responsibility assigned.

- *Calculations*
  - Reviewed in detail to confirm proper use of inputs, assumptions, methods, and tools used.
  - Results are checked for accuracy, reasonableness, and relevance to the defined basis of design and chosen specifications.
  - Computer programs utilized must be validated and verified and fit for purpose.
  - Extrapolation of methods, computational tools, and programs beyond their intended ranges are checked.

- *Drawings, sketches, diagrams, and BIM model*
  - Reviewed to confirm expanded basis of design is fully considered and addressed.
  - Reviewed/checked to confirm design quality throughout the design development process (conceptual and preliminary to final design).
  - Interdisciplinary reviews when design interfaces exist, which assures confidence in design adequacy and integration.
  - As-built drawings produced to reflect final delivered facility and variance from final design documents.

- *Specifications*
  - Review O&M requirements throughout the various design stages to ensure achievement of the O&M aspects of an expanded basis of design.
  - Review technical and test requirements for procurement for completeness and consistency with the developed design.
    - Includes relevant version of an acceptance test specified by code or standard.
  - Review installation/erection requirements as part of the final design.
- *Supplier and vendor submittals and design documents*
  - Reviewed to confirm quality and conformance to procurement specifications.
  - Reviewed to ensure proper integration with the overall design.

Other specialized design reviews may include:

- Reliability/RAM (reliability, availability, maintainability) analyses
  - Ensure consideration of potential failures and their consequences.
- Failure Mode and Effects Analysis (FMEA)
  - Documents current knowledge about the risks of failures.
  - Aids in continuous process improvement.
  - Prevents failures.
  - Used for control before and during ongoing operation of the process.
- Operational design review
  - Ensures consideration of O&M requirements established in the business basis of design and developed through the design development process.
- PDS (Plant Design Systems) models (increasingly being replaced by 3D models)
  - Identifies interference checks.
  - Ensures proper spatial relationships for construction and O&M.

- Confirms compliance to project safety requirements.

Design reviews of final drawings and specifications:

- Confirm client and regulatory requirements are met.
- Confirm quality requirements to be met by suppliers and construction are clearly and completely specified.
- Confirm all acceptance criteria and required tests are detailed.
- Ensure requirements for material identification are given when needed to prevent misuse of materials.
- Ensure completeness of requirements for shipping, handling, installation, operation, storage, and maintenance procedures.
- Ensure well documented basis for quality assurance during procurement, construction, testing, and start-up, including any changes approved as a result of requests for information (RFIs).
- Confirm that enough detail is provided to ensure the quality of the final plant meets the owner's project requirements and the business basis of design.
- Ensure system, structure, equipment, and component identification is complete to facilitate construction and operation and to support the owner's enterprise asset management system.

Emerging challenges in design review include:

- Growing use/reuse of standardized design.
- Growing use of AI-supported "knowledge assemblies" in the design process.
- Changed design sequence required in design-build projects:
  - Horizontal vs vertical slices
  - Granularity of front-end design activities and micro-focus on sequence (myriad of utility relocations or right-of-way acquisition packages).
- Increased use of AI in design tools and programs.
  - Shifts outputs from deterministic to probabilistic.