Reliability, Ageing and Life Extension of Liquefied Natural Gas (LNG) Installations

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Introduction

- The world wide growth of the LNG Industry has not only pushed the development and construction of new facilities, but has increased the demands on existing facilities.
- Existing terminal operators must make dedicated efforts to continuously improve their maintenance and operational practices.
- The relatively small number of LNG installations that each operator tends to operate, prevents the build-up of extensive databases and transference of best practices.
- As the leading industry user organization, the International Group of Liquefied Natural Gas Importers (GIIGNL) determined that it was imperative that the issues associated with the reliability, ageing and life extension activities of LNG import terminals worldwide be examined in detail.

Aim of the Study

- Leverage the knowledge and experience of GIIGNL's permanent Technical Study Group by undertaking a broad study of worldwide LNG maintenance and operational practices. In particular, the following was to be achieved:
  - Benchmarking of present operations to allow for improvement in maintenance schedules and move toward maintenance best practices.
  - Exchange of commercial and general technical information to support decisions relating to the development of new projects or extending the life of existing installations.
  - Providing a basis for discussion with safety and environmental regulators when seeking approval for extending existing operations or starting new ones.

Methods

- Step 1 – Development of a broad understanding of plant reliability and maintenance issues associated with LNG importation facilities worldwide.
- Step 2 – Compilation and analysis of pertinent facility ageing issues with particular attention paid to the life extension activities.
- Step 3 – Benchmarking of maintenance practices.

Results

- Step 1 – Analysis of Reliability and Maintenance Policies (samples)
  - 100% of members have maintenance policy documents.
  - 95% of members have policy objectives.
  - 75% had linked policies to safety management.
  - 80% of members have introduced systems for best practices.
  - 80% of members have monitoring and control systems.
  - 86% of members have formalized management of change.
  - 100% of members have appointed responsible persons.
  - 80% had linked policies to formalized FMEA.
  - 15% include procedures for entire plant shutdowns.
  - 42% review policies on an ad-hoc basis, 38% annual, 20% tbd.

Results

- Step 2 – Analysis of Life Extension Activities (samples)
  - The main expansions are for:
    - Sendout Increase
    - Cogeneration Plants
    - LNG truck loading and unloading
  - The main safety and environmental improvements:
    - Installation of safety automated systems
    - Relocation of control rooms
    - Inspection of cryogenic lines
  - The main replacements have been:
    - Control systems/ESD
    - Instrumentation and electrical equipment
    - Vaporization refurbishment
    - LNG pumps

Results

- Step 3 – Maintenance Benchmarking
  - Detailed data questionnaires on 27 critical equipment groups provided a comprehensive data set of maintenance practices.
  - Limited number of systems excluded.
  - Example of results: LNG Offloading Arms
    - Periodic functional test
    - 6 monthly general visual inspection
    - 5-10 yearly OEM assisted major inspection/overhaul

Conclusions

- Step 1 – Analysis of Reliability and Maintenance Policies
  - All respondents use a variety of strategies.
  - Time based maintenance is still widely used.
  - Duty based maintenance limited.
  - Condition based monitoring limited.
  - Fix on failure only used where redundancy exist or for non critical equipment.
  - Statutory requirements still driving many policies.

Conclusions

- Step 2 – Analysis of Life Extension Activities
  - LNG facilities generally considered evergreen.
  - Storage tanks considered to have something close to an indefinite life.
  - Increased gas demand has been the primary motive behind expansions.
  - Enhanced safety and environmental standards also push the need for life extension initiatives.
  - Replacement of unsuitable, obsolete, unreliable and unrepairable equipment also drove life extension activities.
  - Most programs developed/defined with “in-house” personnel.

Conclusions

- Step 3 – Maintenance Benchmarking
  - Predominance of using historical practice rather than reliability based criteria.
  - Requirements of authorities still driving many maintenance activities verse use of failure modes.
  - A continued reliance on regular feedback from plant personnel.
  - Conformance across diverse geographic spread observed.

Conclusions

- The ability to benchmark present operations helped each of the individual companies in identifying areas for improvement.
- The value of comprehensive and integrated maintenance policies that accommodate the safety management framework of individual facilities was clearly demonstrated
- The results provided a source of information for discussions with safety and environmental regulators.
- The results supported the emphasis on bringing a holistic approach to asset health care in which policies of maintenance management and life extension are integrated and support one another.
- The process fostered the exchange of information and ideas that assisted the GIIGNL members in supporting decisions relating to maintenance policy development and implementation.