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Partnering in Engineering Excellence

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CONTENTS

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Computerized Inspection Management Systems

By Stephen J. Gliebe

A computerized inspection management system may be what you need to help improve fixed equipment reliability and help comply with standards such as the Pressure Vessel Inspection Code (API 510) and local regulations. Before selecting a system, consider the following:

- Objectives. Why change the current system?
  - Regulations
  - Cost reduction
  - Reliability improvement
  - Improved recordkeeping
- Ownership. Who will own and manage the process?
  - Company employee or contractor
  - Maintenance, inspection, operations, safety
- Business processes. What will change?
  - Create a cross functional team
  - Develop new work flows
  - Identify ownership for each part of the process
  - Define how / if information such as inspection recommendations and future work scope will be transferred to the responsible parties (e.g., maintenance, operations)
  - Determine training requirements
  - Update company procedures

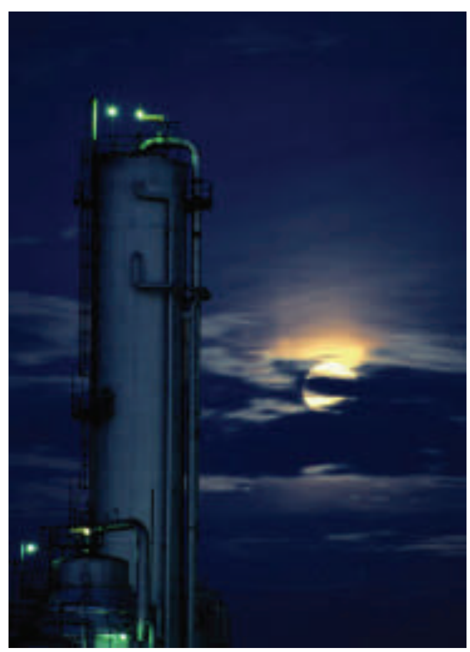
Continued on Page 2

Happy Holidays from Carmagen Engineering

- Data requirements
  - Is the right amount of data being collected?
  - Who will enter the data?
  - Who will analyze the data? What skill sets are needed? Do the skill sets exist in the organization?
  - Where will the data be stored? (e.g., inspection management system, maintenance management system)
  - Are resources available to support the data collection requirements?
- Data integrity
  - Who can view, enter, change, and delete data?
  - How often is data backed up?
- Metrics
  - Establish metrics to measure the performance of the program.
- Software and hardware. Can an existing system be used to meet the objectives? If not, consider software alternatives. Ask the following questions:
  - Does the proposed software match the business process? If not, either the software or the business process will need to change.
  - How does the software interface with the existing maintenance management system (e.g. SAP / Maximo)
  - Is the software easy to use?
  - What is the cost?
    - Data conversion – IT and plant costs associated with converting data from existing systems to import into the new software.
    - Development and configuration – costs to match the software to the current business process. Anticipate ongoing costs to update software as the business needs change.
    - Interfaces – does the software need to interface with the existing maintenance management, RBI, or UT management systems.
    - Licensing
    - Annual maintenance fees – technical support and development of new releases.
    - Resources – design, implementation, start-up, and ongoing support.
  - Resources
    - Cross functional in-house team to support the development and rollout of the new software, troubleshoot product issues, and test and rollout upgrades.
    - External resources to develop the reports needed to manage the business.
    - Data administration and IT support after the system is turned over to the facility.
    - Training – vendor or in house personnel.
  - Software costs may vary depending on the number of users. Determine who needs to have access to the system and how many software licenses are included in the cost.
  - Hardware
    - Are the existing servers adequate for the new software? Will new servers be required?
    - Will desktop upgrades be needed to access the software?

Complete and accessible inspection data is an essential part of an effective inspection program. An effective inspection program provides the foundation for a World-Class Reliability and Maintenance Program.

Steve Gliebe is a Professional Engineer with 28 years experience in the refining and chemical industries. He is well-versed in both engineering and supervision including hands-on experience managing maintenance and capital projects, training union and management colleagues, supervising maintenance/inspection organizations, developing programs for preventative maintenance of fixed equipment and piping per industry standards, and performing root-cause analyses to improve equipment reliability. Please contact Vince Carucci if you'd like more information on Carmagen's expertise in this area.



Changes Contained in Addendum 2 of API 653, Tank Inspection, Repair, Alteration and Reconstruction

By Vincent A. Carucci

This article highlights several of the changes to the Third Edition of API 653 that are contained in Addendum 2 dated November 2005.

- Para. 1.1.1. The introduction was changed to delete the reference to carbon and low alloy steel tanks. It now just references tanks that were built to either API 650 or 12C, which was always its intent. Deleting the explicit material reference now makes it clear that it is intended to also apply API 653 to stainless steel tanks since API 650 now covers stainless steel tanks.
- Para. 3.1. Simplified the definition of "alteration" to "any work that changes physical dimensions or configuration."
- Paras. 3.21 through 3.25. Added definitions for as-built standard, current applicable standard, major alteration or major repair, recognized toughness, and unknown toughness.
- Para. 4.3.3.6. Added an explicit reference to API RP 579 as an acceptable evaluation alternative to procedures that are contained in API 653.
- Para. 4.3.9.1. Adds an explicit statement that may accept existing welds that are closer than API 650 limits if they are not being modified or affected by repairs, provided that specified inspections are done.
- Para. 4.3.10. Added explicit requirements for continued operation of tanks that are in elevated temperature service, and for converting tanks to operate at elevated temperature.
- Para. 5.3.8. Now explicitly recognizes that tanks constructed per a recognized standard other than API 650 that has fracture toughness rules (e.g., API 620) may be used per the current fracture toughness rules of that standard.
- Para. 6.4.3. Adds the presence or absence of a released prevention barrier under the tank as an additional consideration in performing an RBI assessment.
- Para. 9.8.2. For new shell penetrations, a basis is provided for determining required reinforcement area.
- Para. 9.8.3. Specifies when new penetrations must be prefabricated into stress relieved insert plate assemblies.
- Para. 9.9.2.2. Requirements specified for leaving the upper half of an existing reinforcing plate in place while replacing the lower half.
- Para. 9.10.2.2. When a bottom is replaced, requires that for internal floating roofs with aluminum supports, stainless steel or non-metallic spacers must be added to isolate supports from the carbon steel bottom.
- Para. 9.10.2.6. Considerations given when replacing bottom plates in tanks that have cathodic protection or underbottom leak detection.
- New Appendix S. Covers requirements for existing stainless steel tanks that were constructed per Appendix S of API 650. Only states requirements that differ from the basic rules of API 653.

Vincent Carucci, President of Carmagen Engineering, Inc. also provides mechanical engineering expertise in the areas of pressure vessels, heat exchangers, piping systems, and storage tanks to the process and power industries, insurance companies, and attorneys.

Changes in API 650, Welded Steel Tanks for Oil Storage

By Vincent A. Carucci

The following highlights several changes to API 650 that are contained in Addendum 4 to the Tenth Edition dated December 2005.

- Para. 2.2.9.6. New paragraph (although not indicated as such) defines "maximum design temperature." The paragraph appears to be misplaced as part of "toughness requirements."
- Para. 3.1.5.4. Lap-welded bottom plates may now have either "square cut" or "mill" edges (previously had to be square edged). Mill edge requirements are specified.
- Para. 3.1.5.7. Requirements added regarding sizing of shell-to-bottom fillet welds and minimum required distance between the fillet weld and outside edge of the bottom or annular plate.
- Para. 3.2.1. New paragraph that defines the various loads that a tank must be designed for (e.g., dead load, stored liquid design, external pressure, etc.). Note that the design wind speed shall be 120 mph (190 km/hr), the 3-second gust speed determined from ASCE 7, or the 3-second gust speed specified by the purchaser.
- Para. 3.2.2. Adds that the purchaser must also specify the maximum design temperature.
- Para. 3.2.5. Refers to a new Appendix V that contains design requirements for tanks that are subject to partial vacuum conditions exceeding 0.25 kPa (1 in. of water). Tanks that are designed to API 650 requirements are inherently adequate for 0.25 kPa (1 in. of water) without the need for supporting calculations.
- Para. 3.4.2. Minimum bottom plate projection beyond the shell changed from 1 in. (25 mm) to 2 in. (50 mm).
- Para. 3.6.1.4. Deleted requirement that the maximum allowable wind velocity be calculated and reported to the purchaser if it was not originally specified by the purchaser.
- Table 3-2. Added A 841M (A 841) Class 2 (Class 2) plate material.
- Para. 3.6.4.1. Clarified that thickness, t_1, is defined as excluding any specified corrosion allowance.
- Para. 3.6.4.5. Changed definition of t_1 from actual to calculated bottom shell course thickness (less corrosion allowance). Also clarified that t_{2a} excludes any specified corrosion allowance.
- Para. 3.6.4.6. Clarifies that t_u and T_L exclude corrosion allowance.
- Para. 3.7.1.8. Clarifies that welding, in addition to reinforcement, of shell openings that meets API 620 requirements is acceptable.
- Para. 3.7.2.7. New paragraph specifies allowable stresses for the welds that attach a nozzle and reinforcing pad to the shell.
- Table 3-6. Flanged nozzles NPS 1 and NPS 3/4 have been added.
- Para. 3.7.6.2. New paragraph allows shell nozzles without internal piping to be either flush with or project beyond the inside shell surface, unless the purchaser specifies them to be flush, or they are for a floating roof tank.
- Paras. 3.9.6 and 3.9.7. Wind girder equations are changed to be consistent with changed required design wind velocity basis considering 120 mph (190 km/h) rather than 100 mph (160 km/h) and 3-second gust.
- Para. 3.10.2.1. Refers to new Appendix R that defines load combinations that roof and supporting structures must be designed for.
- Para. 3.10.2.3. Modified to permit roof plates of cone roof tanks to be attached to support members if approved by the purchaser. However, the roof cannot be considered frangible in that case.
- Para. 3.10.4.7. New paragraph requires that the design of roof support members consider internal pressure when roof plates are attached to the support members.
- Paras. 3.10.5.1, 3.10.5.2, 3.10.6.1, and 3.10.6.2. Equations used to calculate the minimum required thickness of roof plates modified to consider applied load combinations.
- Para. 3.10.8.3. Maximum internal pressure criteria are specified that must be met when pressure relief devices are used to satisfy emergency venting requirements.
- Paras. 3.11.1, 3.11.2 and 3.11.3. Tanks must be designed for overturning stability (no longer needs to be specified by the purchaser) and design criteria are specified.
- Para. 3.12.9. Maximum allowable stress basis specified for local shell stress at anchor attachment point.

Continued on Page 5

Changes in API 650
Continued from Page 4

- Tables 3-21a and 3-21b. Allowable shell stress at anchor attachment specified for each load case.
- Para. 4.1.3 and Figure 4-1. Shell plate shaping requirements specified in a figure rather than a table.
- Para. 5.2.1.2 and Table 5-1. Minimum preheat temperatures specified based on Material Group and plate thickness.
- Para. 8.1 and Figure 8-1. Revised to require specification of external design pressure (if appropriate) and maximum design pressure on nameplate.
- Para. C.3.4.1c. Alternate floating roof damage criteria permitted for floating roofs 20 ft. (6 m) in diameter or less, with purchaser's approval.
- Para. C.3.5. A pontoon inspection port may substitute for a manhole for floating roofs 20 ft. (6 m) in diameter or less, with purchaser's approval.
- Appendix E. Completely rewritten. Note that there appear to be some typographical errors (e.g., Para. E.6.2.2.3 equations).
- Para. F.4.2. Equations for P_{max} slightly modified.
- Para. G.4.2.2. Wind load basis revised.
- Para. H.4.1.7. An inspection port may substitute for a manhole for floating roofs 20 ft. (6 m) in diameter or less, with purchaser's approval.
- Para. H.5.7. Requirements specified for gauging and sampling devices.
- Appendix M. Generally changed references from maximum operating temperature to maximum design temperature.
- Appendix R. New Appendix R specifies required load combinations to be used in API 650.
- Para. S.3.3.5. New paragraph specifies allowable weld stresses for shell openings.
- Appendix V. New appendix contains requirements for tanks designed to operate with external pressure.

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Cost Management - Part 3 Data Collection and Analysis

By Allen C. Hamilton, PMP CCE

The first two articles in this series introduced the subject of cost management on capital projects, identified its key steps, and discussed cost estimating and cost control. This article discusses data collection and analysis.

Data collection and analysis is one of the most neglected areas of cost management. Data collection and analysis is the process for collecting, analyzing, and applying project historical information to benefit projects. At its best it is logical and methodical in gathering and using this information. All companies and organizations can benefit from this process. Lack of this effort will burden organizations with repeating past mistakes.

It is widely noted that organizations spend a lot of resources to estimate and control but when it comes to collecting and using this experience, the effort falls short. Some efforts to collect data depend on the availability of resources. These resources are frequently hard pressed and are usually busy with current problems and deadlines. It is too easy to neglect data collection until mistakes or inefficiencies are shown after the fact. It has been noted that data collection and analysis link and support the other steps in both the cost management cycle and the project process. The data collection and analysis function can be summarized by the following cycle.

Historical information can be utilized in a variety of ways on projects. The range can be from simple collection to an integrated strategic tool. The collection and use should have a specific benefit to the organization. Potential benefits include more accurate estimates, faster and cheaper bidding, and more profitable projects. Efficient storage can make retrieval quicker and easier. All projects should have a proper close out where the information is collected and handled by prescribed procedures.

A key to data analysis is the input to a system that reflects the specific needs of the organization. These information needs should be established in a plan which should also anticipate information needs based on history, current issues, and forecasts. The

Continued on Page 6

collection and input of data will require resources to be applied over a period of time. Inadequate collection and support of the input system will only serve to generate poor information and waste resources.

The first step in the input process is to collect all available data, both historical and current. This information should include cost, time, and technical documents. One should insure that the collection of documents is as comprehensive as is feasible in cost and time. Many projects collect data when the project is finished, and this can be a problem as the resources may be shifted to other projects. Some organizations solve this problem by collecting and inputting as the project progresses.

The selection of what data to collect may present many challenges. The identification of parameters for each primary account and sub-account is necessary. Parameter selection is important to achieving successful use of the information and establishing a system that can be supported and maintained. Selecting too few parameters will restrict and limit the usefulness of the analysis. Selecting too many parameters will burden staff with gathering unused details, hard to populate database, hamper retrieval and restrict analysis.

To be useful, data input requires judgment regarding what actually goes into the system. The data may need to be authenticated from its source to ensure accuracy. Authentication and audit trails also assist in correcting errors if they should occur. In addition there are also examples of projects and organizations misusing the coding structure. The misuse may be simple errors or attempts to mislead the true source of costs. Whatever the reason, if a coding structure is inaccurate, it will require adjustment prior to inputting to adjust for omissions, errors, and misuse. Finally, old and obsolete data should be deleted from the database to present distortions.

The following illustrates a typical data collection summary table.

Data Collection

				OWNER COSTS			
					COSTS (Millions)		
COST ITEM				HOURS	All-in Labor	Material	Total
Note: When using this form, subcontract and lump-sum costs must be allocated to the appropriate disciplir							
4	ISBL CONSTRUCTION						
1	Civil/Site						$0.000
2	Concrete						$0.000
3	Steel						$0.000
4	Buildings (all-in)						$0.000
5	Equipment	Labor					
		Material	Equipment				
			Bulks				
		Total					$0.000
6	Piping						$0.000
7	Process Air						$0.000
8	Electrical	Labor					
		Material	Equipment*				
			Bulks				
		Total					$0.000
9	Process Control	Labor					
		Material	Equipment*				
			Bulks				
		Total					$0.000
10	Paint/Insulation/Fireproofing						$0.000
	TOTAL - ISBL CONSTRUCTION			0	$0.000	$0.000	$0.000

Closing

In this series of three articles, we have identified and outlined the basic steps in cost management: estimating, control, and data collection and analysis. Organizations will need to identify the best opportunities with the resources they can deploy to each of the key steps in cost management. Many organizations have expertise in one or both of the first two areas of cost management, estimating, and control. We have noted some weaknesses in the ability of organizations to effectively manage data collection and analysis consistent with the effort expended in the other areas. The planning and successful implementation of all of these steps in the project process will ensure efficient and effective management of costs.

Allen Hamilton has over 20 years experience in the management and control of projects, including cost estimating, cost and schedule control and contract management. Please contact Vince Carucci if you'd like more information on Carmagen's expertise in this area.

HIGHLIGHTS

- Completed providing extensive process design services to a major technology developer/licensor.
- Completed pilot plant scale-up development for domestic refiner.
- Providing plot layout support for domestic and international refiners.
- Provided continuous support of a major Middle Eastern LNG project via engineering services at the contractor and the sub-contractor's offices in Europe, with follow-up domestically.
- Provided consultation regarding implementation of systems to meet H_2S emission requirements via vent gas caustic scrubbing, and execution liaison/ expediting with selected vendor.
- Performed HPLC support for domestic refiner.
- Performing preliminary flare network hydraulic analysis, including selected relief valves flare load development.
- Continued relief system helpdesk support for major refiner.
- Performing long-term coordination/support on-site at international refiner's facility during development of their strategic refinery reliability and improvement program.
- Performing strategic reliability initiatives for an international refiner, including the vacuum units, visbreaker, and two hydrocrackers and hydrotreaters and H_2 system.
- Performing fluid coker on-site test run support, and a high level fluid solids section debottlenecking study based upon the results of the performance test.
- Providing on-going fractionation specialist support to a major refiner.
- Providing on-going lubes consultation to a major refiner.
- Supported hydrotreater startups in Texas.
- Supported FCC startups in Venezuela.
- Performing process heat transfer review and exchanger designs of novel AGHR assessment.
- Developed corporate safety standards for a domestic refiner.
- Developed LOPA standards for a domestic refiner.
- Preparing standardized process design notes for a client's licensed technology.
- Providing numerous construction site safety reviews for a major refiner at various refinery locations.
- Providing operating manual support for a major Middle Eastern LNG project via engineering services at the contractor's offices in Japan.
- Performing ASU vendor bid evaluation, Hazop and P&ID review support for a major refining and ethylene project in China.
- Providing mentoring for a technology licensor's staff.
- Performing expanded scope of an Energy Management Study for two Crude Distillation units for a major Gulf Coast refiner.
- Providing process design support in a major technology provider's offices regarding GTL and other related areas.
- Providing process Cold Eyes Review (CER) support in a major technology provider's offices regarding GTL.
- Preparing a Mogas blending study/evaluation of a domestic refinery.
- Provided technical evaluation to improve the reliability of incinerator, waste gas preheater, and vaporizer feed pump, etc., of a BDO unit.
- Performing a consequence analysis study utilizing PHAST modeling for a Middle Eastern client.
- Providing limited process and metallurgical study assistance to a contractor assessing suitability of moth-balled hydrotreater and crude unit equipment for use overseas.
- Providing Hazop leader support for new CCR and HF units located in Greece.
- Providing hydrogen plant technical and reliability support for domestic refiner in the Northwest.
- Provided two process design training courses for Caribbean refiners.
- Provided CER support on Jet Fuel Treater located in Australia.
- Performed scoping study for offsite potential fire hazard.
- Performing analytical support in the area of crude corrosivity.
- Providing technical mentoring/consulting to a university in Ohio.
- Providing extended lube hydrotreating pilot plant support services.
- Providing environmental support to domestic refiner.
- Provided support to a refiner's patent/legal department.
- Providing refractory consulting assistance for Canadian and US refiners, and a US chemicals client, in support of turnaround planning activities and other refractory-related work.
- Continued to provide a US refiner with extensive heat transfer support covering both heat exchangers and fired equipment.

Continued on Page 8

Continued from Page 7

- Continued to provide expert witness assistance to three US based clients.
- Continued to provide electrical engineering support to a US refiner.
- Provided metallurgical expert advice to a US client for repairs to fixed mechanical equipment.
- Continued to provide project management services for a US refiner in multiple locations.
- Continued providing engineering support for an inspection/maintenance improvement program for atmospheric storage tanks for a European refiner.
- Continued providing engineering support for a turnaround improvement program for a European refiner. Includes development of a Turnaround Manual that incorporates “Best Practices” and addresses client-specific matters.
- Provided a fitness for service evaluation of a tower in a petrochemical plant for a Middle Eastern client and a vessel in a fertilizer plant located in Pakistan.
- Providing project management planning support to a US refiner for an upstream project.
- Continued to provide mechanical and materials engineering services for a US chemicals client.
- Providing a qualitative risk-based inspection analysis of selected units for a US chemicals client. The program to date has produced significant reductions in inspection/maintenance budgets, primarily by increasing inspection intervals and using external rather than internal inspection.
- Presented a construction crane safety course for a Canadian refiner.
- Providing engineering support in a petrochemical facility for a Middle Eastern client. This work involves refractory, materials, fired equipment, and process engineering support.
- Presented a refractory training course for a US refiner at multiple refinery locations.
- Providing project management planning support for the assessment of thermal NO_x reduction to meet emissions targets for a US refiner.
- Provided a fired equipment engineer as part of a team performing an energy management survey for a US refiner.
- Provided marine terminal displacement review for a US refiner.
- Provided mentoring in contracts development with new engineers for a US refiner.
- Provided risk based inspection engineering assistance for a UK pharmaceutical client.
- Provided a Cold Eyes Review of a novel process technology.
- Updated instrumentation and controls technical practices for a US refiner.
- Provided project management support to a Canadian refiner.
- Provided critical lift plans review for a Canadian refiner.
- Provided project controls assistance to a US chemicals client.
- Provided mechanical engineering support to a South American refiner. This work involves performing mechanical and thermal stress analyses of the support skirt for the drums on a delayed coker unit, and developing the mechanical design details for replacement skirts that have slotted openings to reduce local thermal stresses.
- Continued to provide mechanical engineering support for a European refiner.
- Provided a marine terminal risk assessment for a US refiner.
- Supported a US refiner with cost estimating assistance.
- Provided third-party, materials engineering review of fire damage assessment performed for equipment located in a Hydrocracker unit. Further materials and mechanical engineering work is anticipated.
- Evaluated acceptability of a higher than design differential pressure across an intermediate catalyst bed in a hydrocracker reactor. Using a beam limit-load analysis, identified an acceptable differential pressure that operations may use for guidance until they shut the unit down for a planned turnaround.
- Presented a course on the design and maintenance of aboveground atmospheric storage tanks at a plant location in Australia. The course was well received, and we anticipate a repeat session in 2007.
- Presented a course covering refractory design and installation for refinery applications at multiple refinery locations. This course is consistently well received, and the information discussed has proven to be of great value to course attendees. We anticipate more sessions will be given in 2007.