



THE INGAA FOUNDATION, INC.

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Fire Prevention and Control in Compressor Buildings



M³ — Measure. Manage. Maximize.®

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Executive Summary

Solomon Associates (Solomon) is pleased to submit the *Fire Prevention and Control Survey* for the results obtained from a survey designed to gather information on the fire prevention and control practices of Interstate Natural Gas Association of America (INGAA) membership.

Some insurance industry loss control inspectors are recommending or requiring installation of active fire suppression systems in natural gas compressor buildings without due consideration of fire prevention efforts or costs versus benefits. The objective of this INGAA membership survey was to determine the extent to which insurance and risk management companies are requesting natural gas transmission companies to install active fire prevention controls, what types of active and passive controls are being used, and the incidence of fires. Active fire controls include a method of distinguishing the fire after ignition, whereas passive controls are methods to minimize fire risk or alert operators of a fire or fire condition. Examples of active and passive controls can be found on the survey form (Appendix A).

Responses were received from 16 of the 19 parent companies contacted, representing 46 operating companies with 4,163 compressor units. INGAA believes that this may be the most comprehensive survey of its type in North America. Key points extracted from the survey are:

- Six fires with damage of greater than \$500,000 were reported for the last 10-year survey period (fire incident frequency is 1.44×10^{-4} per unit per year).
- Approximately 92.5% of the units surveyed were protected by multiple passive fire protection controls, while approximately 7.5% of the units had active fire protection.
- Five of the six incidents with damage greater than \$500,000 fires occurred at units with passive fire; one incident occurred at a location with active fire protection.
- Fire incident frequency rate for reported fires is no higher for units with only passive fire protection controls.
- All reported fires occurred at turbine units, which were 24.3% of the surveyed units.

Introduction

Solomon Associates (Solomon) is pleased to submit the *Fire Prevention and Control Survey* for the results obtained from a survey designed to gather information on the fire prevention and control practices of Interstate Natural Gas Association of America (INGAA) membership.

Insurance industry loss control inspectors are recommending or requiring installation of active fire suppression systems in natural gas compressor buildings without due consideration of fire prevention efforts or costs versus benefits. As such, the focus of this project is to survey INGAA membership to determine the extent of industry concern, identify practices, and frame the issues.

During INGAA's November 2003 Planning and Studies Committee meeting, a project and budget was approved to conduct a survey of member fire prevention and control measures in compressor buildings. Since then, the focus of this project has shifted to include compressor lube oil fire control.

The Strategic Planning Task Group approved the study portion of this project, sponsored by PG&E Gas Transmission NW.

Project Scope and Approach

The objective of this INGAA membership survey was to determine the extent to which insurance and risk management companies are requesting natural gas transmission companies to install active fire prevention controls, what types of active and passive controls are being used, and the incidence of fires. Solomon accomplished this task by requesting basic design characteristics of members' compressor facilities and specifics concerning their fires, fire protection practices, procedures, and equipment. Active fire controls include a method of distinguishing the fire after ignition, whereas passive controls are methods to minimize fire risk or alert operators of a fire or fire condition. Examples of active and passive controls can be found on the survey form (Appendix A). Following is a brief description of the process used.

Solomon, jointly with a project steering committee, assembled a list of survey questions designed to gather information about the basic configuration of INGAA member compressor building operations, current fire control mechanisms, and incidences of compressor building fires. Solomon then reviewed the survey questions with an experienced compressor station insurance inspector to ensure the survey encompassed all relevant issues. The survey was then refined to provide clear definitions and questions, and allow for responses that respond to the objective by allowing answers that can be analyzed and grouped without extensive interpretation.

Following INGAA's and the steering committee's review and approval of the survey, Solomon distributed the survey questionnaire by e-mail to the member list provided by INGAA. Solomon was available to the membership to address any questions or comments from the membership. INGAA members were asked to submit a complete summary questionnaire for all of their gas pipeline company compressor stations. Member responses were accepted at face value, Solomon did no independent verification of the information except to ask clarifying questions of the membership.

Inconsistencies of responses were evaluated on a case-by-case basis favoring a more general response on a company-wide basis rather than focus on individual data points. Solomon did find that some questions were misinterpreted by some responders. For example, questions about frequency of inspections were answered by 4 of the 20 responders with the number of units inspected and not the frequency inspection; these responses were excluded from the calculation of frequency averages for those questions.

Solomon tabulated the completed surveys in such a manner that responses by individual member companies could not be identified. The Master Summary, provided in Attachment A, is a compilation of the raw data that provided the information necessary to indicate response trends and identify the fire mitigation measures versus the incidence of compressor building fires.

Assumptions and Limitations

Solomon undertook and completed this project in a manner consistent with industry standards. As such, Solomon exercised the standards of care, skill, and diligence normally provided by competent professionals in the performance of services such as those contemplated. However, this project is subject to the following assumptions and limitations:

- Information provided to Solomon by the INGAA membership is believed to be true, and no representation or warranty is made as to the completeness or accuracy of information provided to Solomon.
- In all circumstances, the liability of Solomon is limited to the consulting service fee it receives for this project.

Project Results

The initial list of INGAA members included 18 parent companies; however, an additional company was added, bringing the total to 19. Responses were received from 16 parent companies; 13 of which submitted summary information while 3 submitted multiple forms for various combinations of subsidiary operating companies. The results are reported only on a parent company basis, even though some companies submitted information by subsidiary operating company. The results are simple totals without weighting. Responses are summarized as follows:

- Represent some 46 operating companies and approximately 1,372 compressor stations
- Represent approximately 4,163 compressor units reported on by the membership
- Of the 4,163 units reported (1,012 turbines and 3,151 reciprocating):
 - 312 units (7.4%) were equipped with active fire suppression
 - ✦ 306 turbines and 6 reciprocating
 - 3,851 units (92.5%) were protected by passive fire protection
 - ✦ 706 turbines and 3,145 reciprocating
- Of the 3,851 units protected by passive fire protection:
 - Responses listed 29,000 passive controls, leading to the conclusion that units with passive fire control usually have multiple/redundant controls
 - Using simple division (e.g., 403 passive controls/53 units = 7.6 controls per unit), each unit would have passive controls per unit as follows:
 - ✦ Enclosed turbines:
 - 7.6 (not in a building)
 - 10.6 (in single unit buildings)
 - 11.5 (in multi-unit buildings)
 - ✦ Un-enclosed turbines:
 - 8.6 (in single unit buildings)
 - 8.8 (in multi-unit buildings)
 - ✦ Reciprocating units:
 - 7.2 (indoor)
 - 4.8 (outdoor)

-
- The top 5 passive controls are as follows:
 - ✦ Gas detectors for leaks
 - ✦ Equipment failure shutdown
 - ✦ Unit shut down when low lube oil level
 - ✦ No bulk oil stored in building
 - ✦ Buildings compliance with National Fire Protection Association (NFPA) Class 1 Division 1 or 2
 - 6 fires were reported for the last 10-year period (fire incident frequency is 1.44×10^{-4} per unit per year):
 - 5 fires with damage >\$500,000 but <\$3,000,000 (all un-enclosed turbines in buildings):
 - ✦ 4 of these fires were at units with only passive fire controls.
 - ✦ 1 fire was at a unit with active control (CO₂ fire suppression).
 - ✦ 3 fires were in single-unit buildings and two in multi-unit buildings.
 - 1 fire resulted in damages >\$3,000,000:
 - ✦ Fire occurred in a single-unit building with passive fire control.
 - The frequency at which fires with passive controls and damage greater than \$500,000 was not higher than fires with active controls.
 - 5 fires out of 3,851 passive controlled units (frequency of 1.3×10^{-4} per unit per year)
 - 1 fire out of 312 with active controlled units (frequency of 3.21×10^{-4} per unit per year)
 - 4 parent companies reported the 6 fires.
 - 3 parent companies have been asked by their insurance or risk-management companies to install active fire suppression systems on a total of 158 units (0.38% of total units reported)
 - 2 of the 3 companies had not reported a fire
 - 3 of the 4 parent companies that reported fires were not asked by their insurance or risk-management companies to install active fire suppression systems.
 - 1 of the 4 parent companies that reported a fire had been asked by their insurance or risk-management companies to install active fire suppression systems.
 - 14 of the 16 responding companies had a formal program of periodic physical inspection.
 - 11 of the 16 responding companies maintain a formal personnel training program to look for leaks or potential leaks.
 - 6 of the 10 responding companies that have enclosed turbines maintained / tested for enclosure seal integrity.

Summary

This survey report and the Master Summary represent the completion of the approved Phase I exercise to conduct a fire prevention and control survey in the compressor buildings on behalf of INGAA. Attached is the Master Summary that compiles the data submitted by the INGAA membership surveyed. The Master Summary is a Microsoft® Excel tabulation or average of the 16 parent company questionnaires.

Further analysis and or preparation of a presentation document is pending the approval and funding of Phase II by INGAA and the steering committee.

Attachment A Master Summary Document

Important - Survey excludes units with electric drivers except for question 11.

Please replace this text with your company name.

1 List the number of units in each category:

- a. Aqueous fire-fighting foam (AFFF) fire suppression system
- b. CO₂ fire suppression system installed
- c. Halon fire suppression system installed
- d. High expansion foam fire suppression system installed
- e. Passive fire controls only (spacing, emergency shutdown protection, maintenance practices)

No. of Enclosed Turbine Units (Turbines in Housings) No. of Un-Enclosed Turbine Units No. of Recip Units

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor
		4	11	10	6	
16	82	29	7			
2	6	14	5			
	92	18	7	3		
53	58	28	255	312	3,110	35

2 For passive fire controlled units only, list the number of units with:

- a. Lube oil flash point greater than unit skin temperature
- b. Dry gas seals
- c. Seal oil piping systems welded
- d. Lube oil pumps shut off with detection of fire
- e. Unit shut down when low lube oil level in reservoir is detected
- f. Emergency shutdown evacuates the compressors of gas
- g. Single-type fire detection sensor (e.g., thermal, infrared, etc.)
- h. Multiple-type fire detection sensors
- i. Gas detectors for leaks
- j. Electric power removed on gas detection
- k. Methanol in cooling system
- l. Equipment failure shutdown system (e.g., vibration, bearing temp, etc.)
- m. Manned (24 hour) station with trained fire-fighting personnel
- n. No bulk oil (excluding operating reservoir) stored inside buildings
- o. Remote bulk oil pressure delivery system disabled on emergency shutdown
- p. Buildings classified as National Fire Protection Association (NFPA) Code Class 1 Division 1 for basement and Class 1 Division 2 working floor

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor
21	59	19	76	154	1,647	9
4	58	2	141	95	29	
38	11	25	124	232	68	
12	57		93	110	1,100	19
56	62	31	247	320	1,966	33
55	62	31	247	320	2,442	20
38	48	21	87	84	1,087	7
19	14	18	147	164	1,557	4
59	62	46	251	323	3,117	17
35	7	32	136	176	1,304	16
					276	
59	62	46	251	323	2,978	36
1	1	6	21	36	658	3
	50	20	158	150	1,900	
6	3	9	42	54	711	4
	59	16	184	221	1,684	

3 [X] the box to indicate your current fire control design standard for each type of unit; enter [X] in line below if not applicable:

- a. Aqueous fire-fighting foam (AFFF) fire suppression system
- b. CO₂ fire suppression system
- c. Halon fire suppression system
- d. High expansion foam fire suppression system
- e. Manned (24 hour) station with trained fire-fighting personnel
- f. Passive fire controls only
- g. Not applicable

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor
		1	1			
2	1	1				
		1			1	
4	2	3	11	8	12	2
2	3	2	1	1	1	5

4 Indicate the number of oil-/methanol-related fires you have had that have resulted in damage greater than \$500,000 but less than \$3,000,000 for each type of unit in the last 10 years:

4.1 Excluding business interruption:

- a. Aqueous fire-fighting foam (AFFF) fire suppression system
- b. CO₂ fire suppression system
- c. Halon fire suppression system
- d. High expansion foam fire suppression system
- e. Manned (24 hour) station with trained fire-fighting personnel
- f. Passive fire controls only

NIB	ISUB	IMUB	ISUB	IMUB	Indoor O/M	Outdoor O/M
			2	1		

4.2 Including business interruption:

- a. Aqueous fire-fighting foam (AFFF) fire suppression system
- b. CO₂ fire suppression system
- c. Halon fire suppression system
- d. High expansion foam fire suppression system
- e. Manned (24 hour) station with trained fire-fighting personnel
- f. Passive fire controls only

NIB	ISUB	IMUB	ISUB	IMUB	Indoor O/M	Outdoor O/M
			1			
					1	

5 Indicate the number of oil-/methanol-related fires you have had that have resulted in damage greater than \$3,000,000 for each type of unit in the last 10 years:

5.1 Excluding business interruption:

- a. Aqueous fire-fighting foam (AFFF) fire suppression system
- b. CO₂ fire suppression system
- c. Halon fire suppression system
- d. High expansion foam fire suppression system
- e. Manned (24 hour) station with trained fire-fighting personnel
- f. Passive fire controls only

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor
			1			

5.2 Including business interruption:

- a. Aqueous fire-fighting foam (AFFF) fire suppression system
- b. CO₂ fire suppression system
- c. Halon fire suppression system
- d. High expansion foam fire suppression system
- e. Manned (24 hour) station with trained fire-fighting personnel
- f. Passive fire controls only

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor

6 Do you have a formal program for periodic physical inspection and repair of indicators (e.g., vibration) of potential oil leaks? Enter Y or N.

Y/N

If yes, what is the frequency? (every ____ days)

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor	AVERAGE
94	46	61	76	103	85	121	

7 Do you have a formal personnel training program to instruct employees to look for potential leaks? Enter Y or N.

Y/N

8 For passive fire controlled units only, how many units has your insurance or risk management company requested that you install active fire suppression systems?

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor
1			50	19	88	

9 Do you plan to install active fire suppression per these requests? Enter Y or N.

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor	Y/N
0/9	0/6	0/7	0/13	0/11	0/11	0/6	

10 Are the enclosed units maintained/tested for enclosure seal integrity? Enter Y or N.

Y/N

If yes, what is frequency? (every ____ days)

NIB	ISUB	IMUB	AVERAGE
90	243	365	

11 Do you have electric drivers? Enter Y or N. If yes, address the following:

Y/N

- a. How many units do you have?
- b. How many have active fire suppression?
- c. Are you considering active fire suppression? Enter Y or N.

NIB	ISUB	IMUB	ISUB	IMUB	Indoor	Outdoor	Y/N
20	29	129					
0	6	11					
0/1	0/2	0/1					

12 Who is your primary insurance or risk management company?

Comments:

Legend
NIB - Not in Building
ISUB - In Single-Unit Building
IMUB - In Multiple-Unit Building