

LEADING INDICATORS:

The Elusive “Holy Grail” of Safety and Health Risk Management

SAFETY & HEALTH LEARNING ALLIANCE



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LEADING INDICATORS:
The Elusive “Holy Grail” of Safety and Health Risk Management

SAFETY & HEALTH
LEARNING ALLIANCE

Featuring Guest Speakers
Gary DeMoss, Jeff Ruebesam, and David Loyd
June 20, 2013



Gary DeMoss



Jeff Ruebesam



David Loyd

Logistics

- Facilitator introduction
 - Mike Lipka, Knowledge Management Officer, NASA Safety Center
- To ask a question, click the icon of a figure raising its hand (top of screen) and click the “Raise Hand” option, or use the chat function to the right of the presentation
 - Please “lower your hand” after you are called on to ask your question
 - Questions asked in chat will appear to everyone in attendance
- The presentation will last approximately an hour and a half
- To get a closer look at the slides, select “Full Screen”



Agenda

- Goals of the Safety and Health Learning Alliance (SHLA)
- Guidelines for sharing knowledge
- Who's Who
- Panel presentations
- Discussion and key points
- Wrap-up and next event

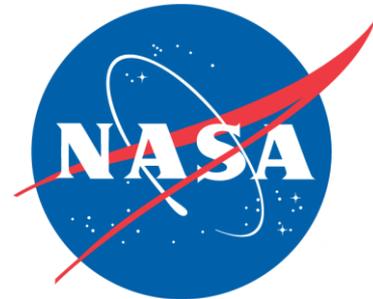
Goals of the SHLA: the Four C's

- **COLLABORATE** Create a forum for collaboration
 - Repeatable process with trusted advisors
- **CONCENTRATE** Accelerate learning
 - “Quick hits” on timely, topical, and new approaches
- **CONTEXT** Learn from your peers—what they do and how they do it
 - Knowledge + Experience = Wisdom
- **CONNECT** Establish networking opportunities
 - Extend beyond events for personal and professional development

Guidelines for Sharing Knowledge

- Do not include Sensitive but Unclassified, Classified, or Secret information
- Examine topics of mutual interest
- Maintain scope of government, defense, and professional organizations
- Use the SHLA Web site, hosted by the NASA Safety Center, to
 - Communicate upcoming events
 - Solicit participation for events
 - Store presentations, videos, and event summaries

Who's Who



Introduction to Leading Indicators



Today's Panel



Gary DeMoss

Chief, Performance & Reliability Branch
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission



Jeff Ruebesam

Vice President, Health, Safety & Environmental
Fluor



David Loyd

Chief, Safety & Test Operations Division
NASA Johnson Space Center

Gary DeMoss

*Chief, Performance & Reliability Branch
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission*



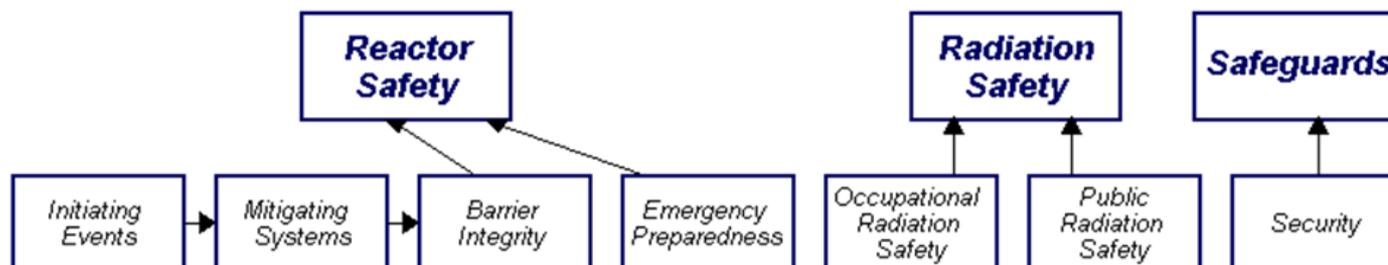
Nuclear Regulatory Commission's (NRC) Programs

- Performance Indicators (PI)
 - Support the Reactor Oversight Program (inspection)
 - Started around 2000
- Industry Trends Program (ITP)
 - Measure NRC's and industry's safety performance
 - Started in the mid-1980s
 - Reported annually to Congress

Performance Indicators

- Performance indicator data voluntarily collected by reactor facility, reported to NRC
- Serve as inputs to assessment and additional inspection efforts
- Provide a broad sample of data to assess reactor facilities performance in each cornerstone area
- Objective thresholds establish the level of regulatory engagement appropriate for reactor facility performance in each cornerstone area
- Inspection to verify performance indicator data
- Some are risk-informed, others are not

Performance Indicators



Performance Indicators

Unplanned Scrams (G)	Safety System Functional Failures (G)	Reactor Coolant System Activity (G)	Drill/Exercise Performance (G)	Occupational Exposure Control Effectiveness (G)	RETS/ODCM Radiological Effluent (G)	Protected Area Equipment (G)
Unplanned Power Changes (G)	Emergency AC Power System (G)	Reactor Coolant System Leakage (G)	ERO Drill Participation (G)			
Unplanned Scrams with Complications (G)	High Pressure Injection System (G)		Alert and Notification System (G)			
	Heat Removal System (G)					
	Residual Heat Removal System (G)					
	Cooling Water Systems (G)					

Indicator Thresholds

Green: Performance within an expected performance level where the associated cornerstone objectives are met

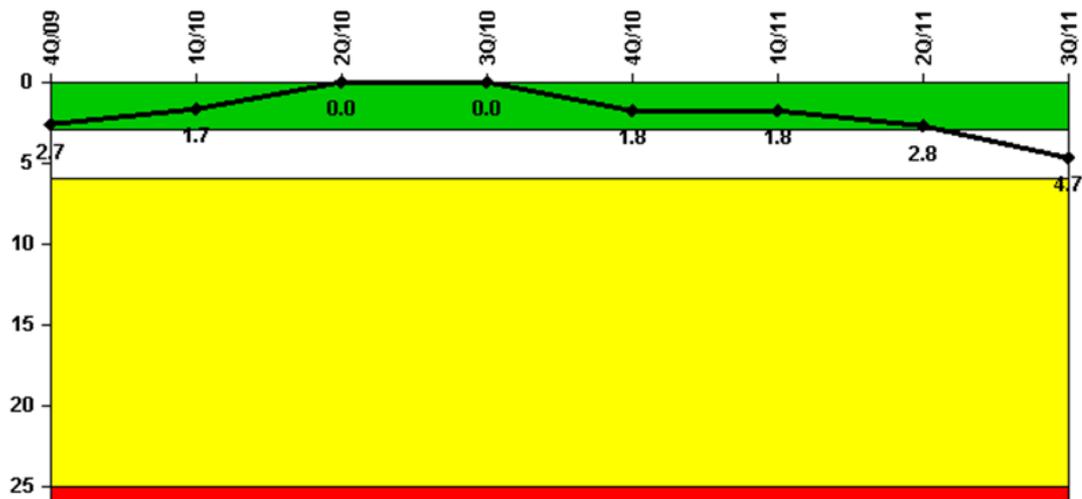
White: Performance outside an expected range of nominal utility performance, but related cornerstone objectives are still being met

Yellow: Related cornerstone objectives are being met, but with a minimal reduction in the safety margin

Red: Significant reduction in safety margin in the area measured by the performance indicator

Indicator Sample

Unplanned Scrams per 7000 Critical Hrs



Thresholds: White > 3.0 Yellow > 6.0 Red > 25.0

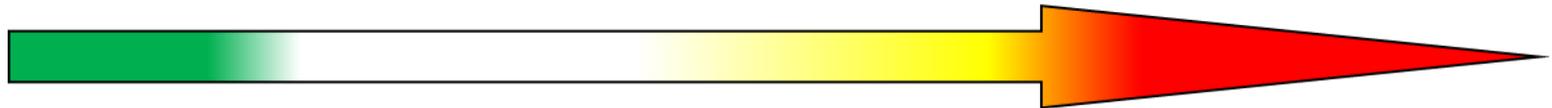
Notes

Unplanned Scrams per 7000 Critical Hrs	4Q/09	1Q/10	2Q/10	3Q/10	4Q/10	1Q/11	2Q/11	3Q/11
Unplanned scrams	0	0	0	0	2.0	0	1.0	2.0
Critical hours	2209.0	2159.0	2184.0	2208.0	1022.1	2159.0	2155.8	2141.4
Indicator value	2.7	1.7	0	0	1.8	1.8	2.8	4.7

Performance Indicator Assessment

- Performance indicators and inspection findings both considered for an overall assessment of licensee performance

Licensee Response	Regulatory Response	Degraded Cornerstone	Multiple/Rep. Degraded Cornerstone	Unacceptable Performance
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- Increasing safety significance
- Increasing NRC inspection efforts
- Increasing NRC/facility management involvement
- Increasing regulatory actions

Industry Trends Program

- Purpose: Provide means to assess whether the nuclear industry is maintaining the safety performance of operating reactors, and to identify significant trends in safety performance
- Objectives
 - Provide feedback to the Reactor Oversight Process
 - Assess the safety significance and cause of any statistically significant adverse industry trends
 - Communicate to Congress and stakeholders
 - Support the NRC's performance goal of safety

Industry Trends Program Process

- Three areas of evaluation
 - Long-term trending (10 years)
 - Short-term trending (annual)
 - Baseline Risk Index for Initiating Events (BRIIE)
- Collect indicator data
- Use prediction limits to identify short-term issues
- Use trend lines to identify statistically significant long-term adverse trends
- Evaluate BRIIE results
- Analyze identified issues
- Respond as appropriate
- Communicate results

Industry Trends Program Indicators

- Automatic scrams while critical
- Safety systems actuations
- Significant events
- Safety system failures
- Forced outage rate
- Equipment forced outages
- Collective radiation exposure
- Unplanned power changes
- Reactor coolant system activity
- Reactor coolant system leakage
- Drill and exercise performance
- Emergency response organization drill participation
- Alert and notification system reliability
- Accident Sequence Precursors
- BRIIE events
 - General transient
 - Loss of condenser heat sink
 - Loss of main feedwater
 - Loss of off-site power
 - Loss of vital AC bus
 - Loss of vital DC bus
 - Stuck open safety/relief valve
 - Loss of instrument air
 - Very small loss of coolant accident
 - PWR-Steam generator tube rupture

Questions

- Questions?
- Contact information
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 - Gary.DeMoss@NRC.gov

Jeff Ruebesam

Vice President

Health, Safety & Environmental

Fluor



Fluor Corporation

- One of the world's leading publicly traded engineering, procurement, construction, maintenance, and project management companies
- **43,000** employees executing more than **1,000** projects annually, serving more than **600** clients in **66** different countries, with annual revenue exceeding **\$27 billion**
- In 2011, named one of **America's Safest Companies** by EHS Today magazine
- Celebrated **100** years in **2012**



Fluor Corporate Headquarters
Dallas, Texas

Fluor's Business Lines



Energy & Chemicals

- ◆ **Chemicals**
- ◆ **Upstream**
- ◆ **Downstream**
- ◆ **Offshore Solutions**



Industrial & Infrastructure

- ◆ **Mining & Metals**
- ◆ **Transportation**
- ◆ **Alternative Power**
- ◆ **Commercial & Institutional**
- ◆ **Healthcare**
- ◆ **Life Sciences**
- ◆ **Manufacturing**
- ◆ **Telecommunications**
- ◆ **Water**
- ◆ **Operations & Maintenance**



Government

- ◆ **Department of Defense**
- ◆ **Department of Energy**
- ◆ **Department of Homeland Security**
- ◆ **Department of Labor**
- ◆ **NASA**
- ◆ **UK Nuclear Decommissioning Authority**



Power

- ◆ **Power Services**
- ◆ **Gas-Fueled/IGCC**
- ◆ **Solid-Fueled**
- ◆ **Renewable Energy**
- ◆ **Nuclear**
- ◆ **Environmental Compliance**



Global Services

- ◆ **Construction Equipment & Tools**
- ◆ **Staffing**

Fluor's Core Values (SITE)

Safety

We hold sacred the current and future well-being of people—employees, customers, and communities—in which we work and live.

Teamwork

We treat all people with dignity, respect each other's perspective, and share knowledge and resources to achieve excellence, deliver value, and grow individually and collectively.

Integrity

We live by the highest standards. Our actions are consistent with our values and principles.

Excellence

We strive to deliver quality, fit-for-purpose solutions at unmatched value.



Health, Safety, and Environmental (HSE) Challenges



- Diverse industries and environments
- Unique client requirements and joint ventures
- Regional/country cultural differences and work norms
- Large and small projects

Making HSE Part of the Company Fabric

- All meetings of four or more begin with an HSE topic
- All projects and service activities align with Fluor's *ZERO IncidentsSM Program*
- All employees are measured annually on HSE performance
- All executives, including the CEO, have specific HSE compensation metrics
 - Lagging indicators (TCIR and LT Rates)
 - Leading indicators (HSE Audit Performance)

Fluor's ZERO Incidents Program

12 High-Impact Incident Reduction Techniques

1. Subcontractor Management
2. Pre-Project HSE
3. HSE Education and Orientation
4. New Employee Development
5. HSE Awareness Program
6. Substance Abuse Program
7. Recognition and Rewards
8. Incident Reporting and Investigation
9. Pretask Planning
10. Management In Action
11. Audit/Assessments
12. Use of Networking and Resources

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Leading Indicators

- Fluor's goal: Learn more faster, spot problem areas, and take action before someone gets hurt, non-compliance results, a client is disappointed, or our HSE culture/reputation is negatively impacted
- Leading indicator programs
 - Corporate
 - Sites



Corporate HSE Leading Indicator Program

HSE Audit focused on

- HSE program development and coordination
- Management in action
- Training, communication, and HSE culture initiatives
- Field execution



Note: An unsatisfactory HSE Audit requires project leadership to meet with CEO and HSE VP

HSE Audit Tool

- **Excellent—100%:** Exceptional Compliance/Reflects Fluor's high standard of HSE excellence/Free of deficiencies/"Best practice" performance
- **Good—85%:** Adequately meets the intended objective/Only minor improvements needed to achieve “Best Practice” performance/Competent performance demonstrated
- **Improvement Required—70%:** Mediocre Compliance/Entailing numerous deficiencies/Does not meet Fluor expectations
- **Unsatisfactory—50%:** Fail/Unacceptably poor performance
- **Imminent Danger—0%:** A severe threat immediately dangerous to life and health
- **Not Applicable:** Not Relevant/Not Observed

HSE Corporate Audit Score Card			
Project:			
Audit Date:			
Audit Team:			
Section I: Program Development and Coordination		Audit Item Descriptor	Score
Project Critical Process			
1	Site-Specific HSE Plan / Manual	Excellent	100
2	Pretask Planning (JSAs, STAs)	Good	85
3	Weekly HSE Assessments	Excellent	100
4	Medical Provisions / Claims Management	Good	85
5	Injury/Illness Recordkeeping / Proportionate Injury Triangle Analysis	Good	85
6	Incident Investigation / Reporting	Good	85
7	Adequate HSE & Supervision-to-worker ratio	Unsatisfactory	50
8	Substance Abuse Program	Not Applicable	N/A
9	Subcontractor Selection and Prequalification	Good	85
10	Subcontractor Alignment and Kick-Off Documentation	Improvement Required	70
			83
Section II: Management in Action			
Project Critical Process			
1	Management clearly demonstrates ownership and accountability for HSE matters	Excellent	100
2	Management participation in orientation process	Excellent	100
3	Management participation in STA meetings	Good	85
4	Management participation in weekly site HSE assessments	Excellent	100
5	Management participation in the investigation of recordables and serious near misses	Unsatisfactory	50
6	Disciplinary Action Process enforced and consistent	Good	85
7	Lessons Learned are shared	Good	85
8	Action Plans in place for audit / assessment findings	Good	85
9	Site Leadership effectively escalates critical safety issues to senior management personnel	Improvement Required	70
10	HSE takes precedent over schedule and cost	Good	85
11	Recognition program encourages participation and promotes safe behavior of staff & subcontractors	Excellent	100
12	Contractor Oversight and Coordination	Good	85
			85

Standard Site Leading Indicator Program

- Management participation with crew Safety Task Assignment (STA) meetings (two minimum/week)
- STA quality check (minimum of 10% of all STAs)
- Supervisor completion of weekly scored HSE Audit of own area
- Management participation in weekly site-wide HSE Audit
- All management personnel complete HSE leadership training (100% within 6 months of assignment)



Benefits of Leading Indicator Programs

- With craft
 - Build trust
 - Raise awareness
 - Engage everyone
- With leadership
 - Education and buy-in
 - Active program participation
 - Consistent actions that support messages
- With programs
 - Effective data collection
 - Analysis
 - Corrective measures



Questions

- Questions?

David Loyd

*Chief, Safety & Test Operations Division
NASA Johnson Space Center*



Thoughts on Leading Indicators

- Leading indicators are about lowering risk posture, not predicting (much less preventing) the next accident
- Lagging indicators must not be dismissed because they are a reliable and consistent measure of safety performance
- Many leading indicators are, by nature, subjective, which requires that several indicators (leading and lagging) must be viewed in context with one another
- If you can effectively target your safety and health program focus (with fewer resources) using leading indicators, and positively influence lagging indicators, you are probably looking at the right things

Johnson Space Center Concept for Safety and Health Performance Measurement

- Reflects Center emphasis on Safety and Health Program actions, “Beyond the Numbers”
- Criteria used for assessment of Center-wide performance, including contractor Safety and Health performance

Leadership (Leading Measures)

“Safety” is an integral part of great leadership—“leadership” is an integral part of an effective Safety and Health program

Prevention (Leading Measures)

A Safety and Health Program that meets or exceed requirements—using a proactive, inclusive approach to identifying and controlling hazards

Reaction (Lagging Measures)

We expect to achieve injury/illness rates well below the industry average, and we strive for zero—“zero” only has meaning if it is achieved through a proactive Safety and Health Program

Issue Resolution (Lagging Measures)

Manage significant events and implement appropriate risk mitigation and hazard control

- Some of the above criteria are qualitatively assessed
- Quantitative measures are assessed in context with circumstances and other pertinent information
- General improvement is stressed over arbitrary performance targets

Safety and Health Performance Measures

Leadership

Continue to encourage safe behaviors, attitudes, and employee involvement.

EXAMPLE MEASURES

- *S&H Topic & Forum Participation*
- *Center & Individual Recognitions*
- *JSAT Sponsorship*

LEADING MEASURES

Prevention

Improve employee participation in prevention activities.

EXAMPLE MEASURES

- *S&H Training Delivery*
- *Close Call Submission & Acceptance*
- *BITS Completion*

Reaction

Reduce mishaps and improve investigation response.

EXAMPLE MEASURES

- *Mishap Rate vs. Industry vs. NASA Target*
- *Event Rate Performance*
- *Mishap Timeliness Metric*

LAGGING MEASURES

Issue Resolution

Assure response to challenges reflect thoughtful approach to risk mitigation.

EXAMPLE MEASURES

- *Minimized Issue Impact*
- *Feedback on Issue Response*
- *Effectiveness of Corrective Actions*

2012 Final Performance (Measures are comparisons with 2011)

• **Acceptable Performance**

Leadership

- Senior Staff Topic participation is limited
- Safety Forum & Awareness is stable
- Successful JSAT sponsorship
- “Safe, Not Sorry” recognition program shows consistent participation
- JLT Safety Pulse Check is STRONG
- 2012 survey indicates JSC’s Safety Culture is STRONG

• **Improvement Needed**

• **Immediate Risk**

Prevention

- Close Call response satisfaction is high
- Close Call total submittals stabilizing
- S&H mandatory training is greater than 94%
- BITS completion average is at 87%
- 2012 Facility Baseline Documentation assessments indicate 98% hazard control resolutions

Reaction

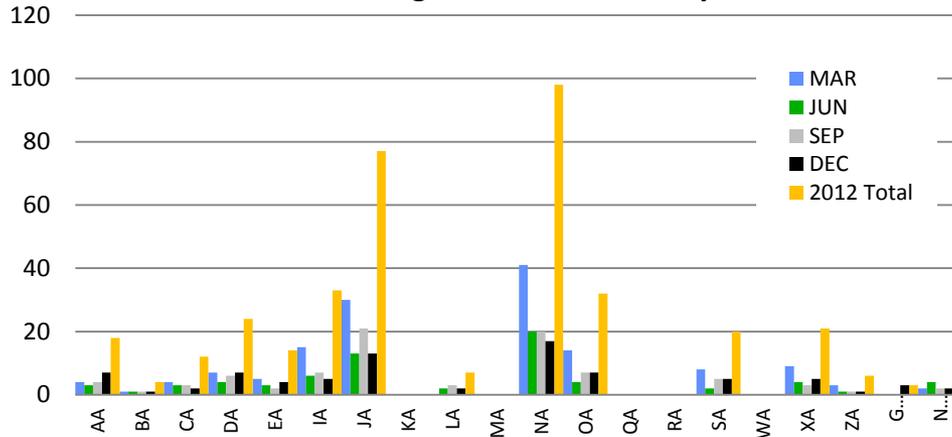
- EAP utilization is down, but cautionary
- JSC Clinic visits are within acceptable range
- CY12 JSC TEAM Recordable Rate 54% below industry standard—lowest rate ever at JSC
- Injury severity has been reduced
- Health complaint trend is down
- Damage mishap value is down ~60%
- Mishap investigation timeliness meets Agency standards

Issue Resolution

- Budget impacts pose risk to workplace safety and health
- JSC Integrated Risk Review has proven to be effective at encouraging cross-organizational risk identification and mitigation planning
- JSC Emergency Response is meeting standards for on-scene timeliness
- HATS processing is addressing facility hazards

Leadership—Example Measures

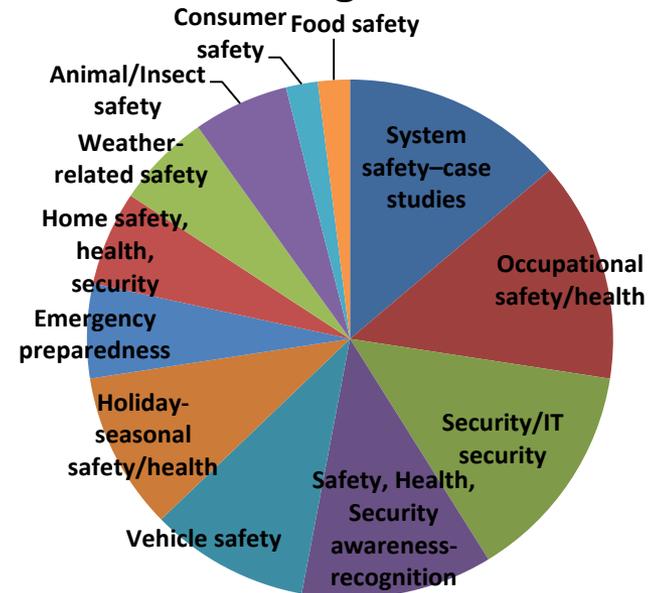
2012 CSF Meeting Attendance Totals by Directorate



2012 Safety Culture Survey Results



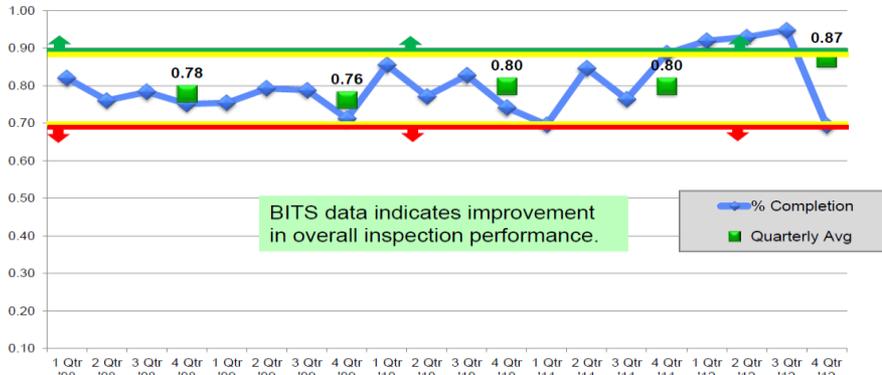
2012 Safety and Health Message Categories



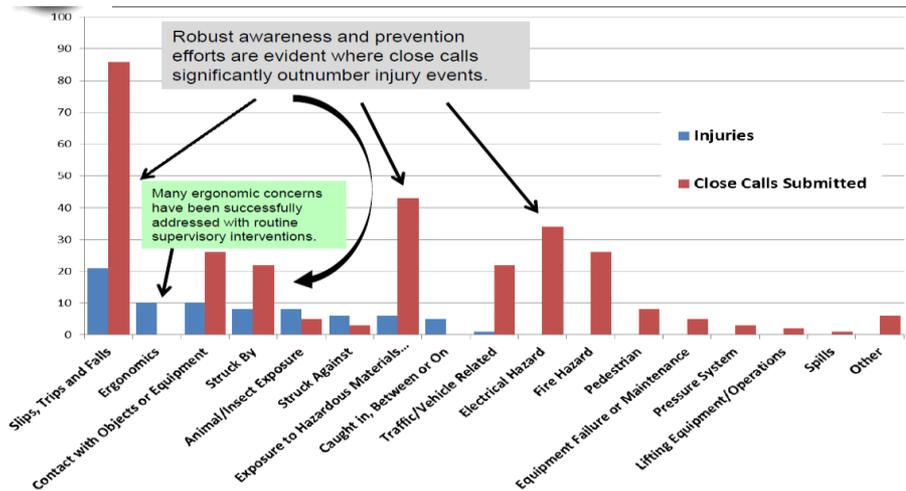
Prevention—Example Measures

Workplace Inspections

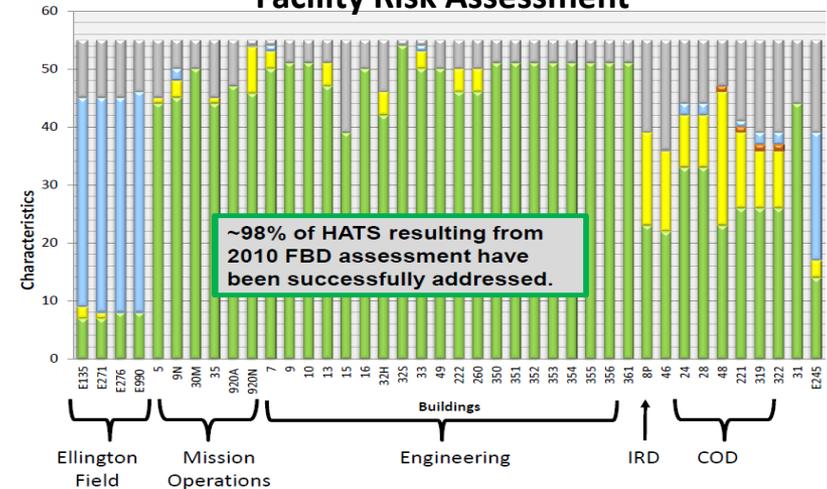
JSC BUILDING INSPECTION REPORT (BITS) for CY12 -- Qtr4
Data from 1/1/2012 thru 12/31/2012



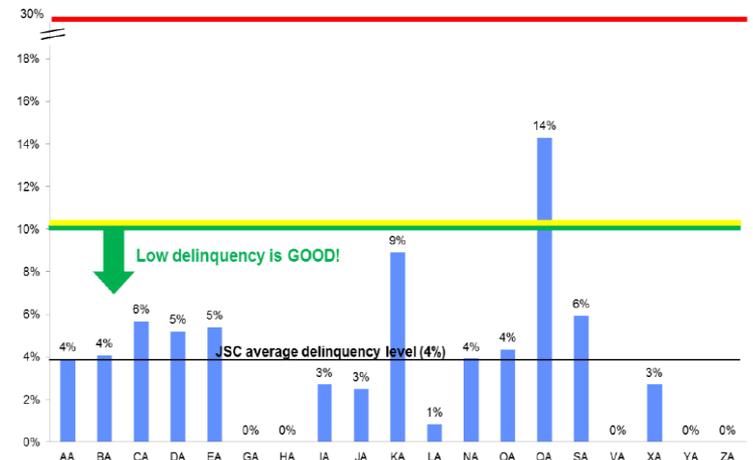
Injuries vs. Close Calls in FY12



Facility Risk Assessment



Training Delinquency



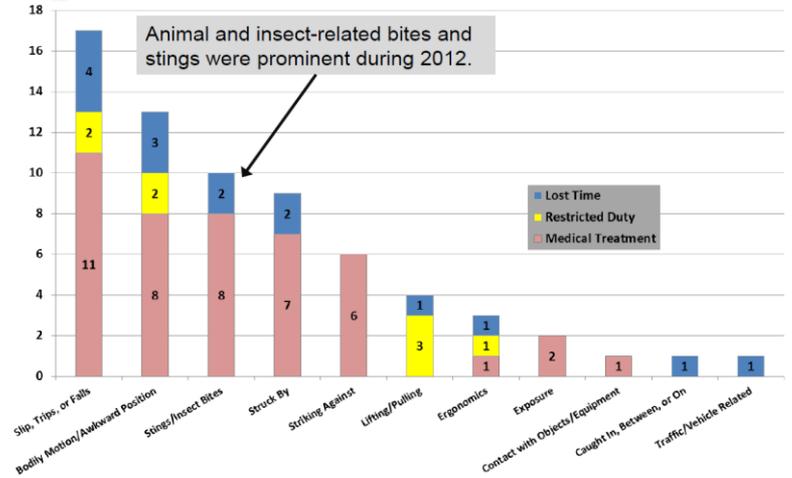
Reaction—Example Measures

Injury Rates

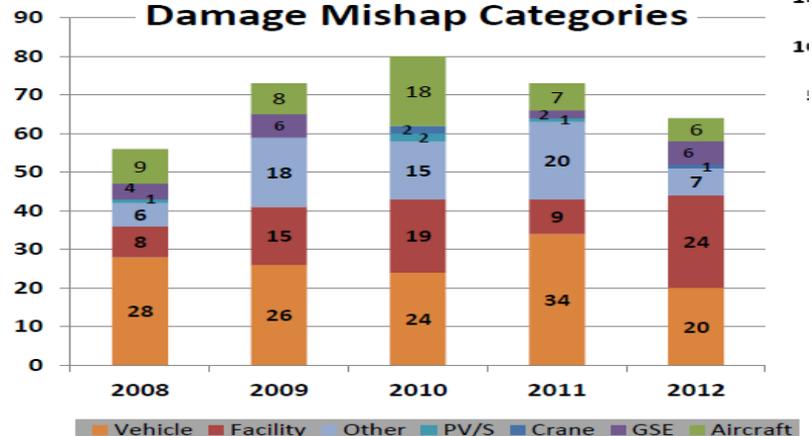
Category	**JSC Team Target	JSC Team Actual	Ind. Avg. (team)	***Civil Service Target	Civil Service Actual	JSC Contractor Target	Contractor Actual
Lost Workday Case Frequency Rate	0.19	0.15	0.49	1.00	0.00	0.25	0.23
Lost Workday Case Frequency Rate (D.A & R.D.)	0.38	0.23	0.74	1.00	0.04	0.53	0.34
OSHA Recordable Rate (Includes days away, restricted duty, & medical treatment)	0.95	0.75	1.64	1.00	0.29	1.2	1.00
Severity Rate	4.96	4.26		15	0.00	7.22	6.52
Property Damage Rate (>\$1K)	0.20	0.31		0.29	0.36	0.2	0.28
Days Away		345			0		345
Property Damage		\$217k			\$143K		\$74K
Close Calls		289 Includes Anonymous			59		221

*Blue = Meets or exceeds JSC Target
 *Green = Within 25% of JSC Target
 *Yellow = Greater than 25% above JSC Target, Below Industry Average
 *Red = Greater than Industry Average
 **Industry Averages are based on JSC Team weighted industry averages
 ***JSC Team Target = 10% reduction of previous JSC Team 3-year average
 **** Civil Service Goal = POWER mandates for Federal Employees

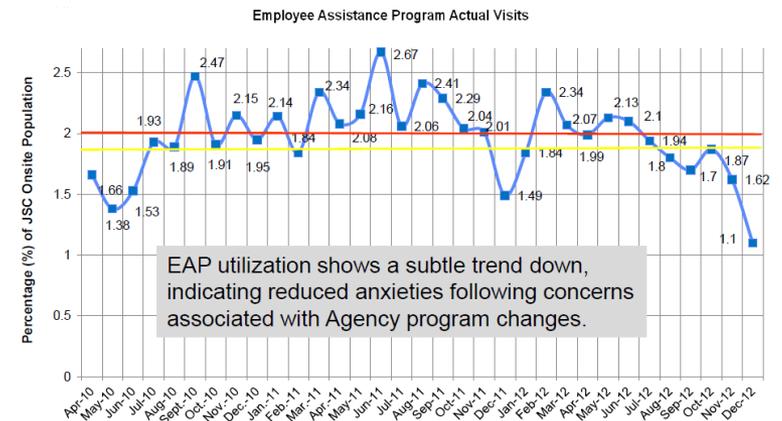
Mishap Exposures



Damage Mishap Categories



Employee Assistance Contacts

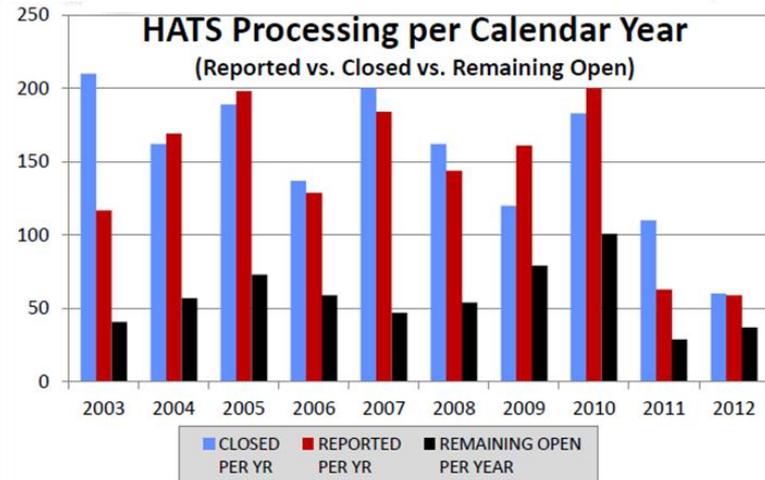


Issue Resolution—Example Measures

Top Center Risk Mitigation Plans

JSC-IRMA Risk Reference	Score (L X C)	Description
TCR 1606 – Maintenance & Repair IDIQ Shortfall. FY13 Mitigation cost: \$170K	4 x 4	Curtain wall repairs phase 1 – A catastrophic failure of 10 curtain wall panels at B11 led to a site investigation of similar facilities. Foundation settling has created a similar failure mode to exist in 16 other JSC buildings.
TCR 1815 – IT Security Planning and Certification. FY13 Mitigation cost: \$390K	5 x 4	Inadequate funding is available to fully fund IT security plan certification and accreditation process. Security vulnerabilities may emerge resulting in heightened exposure to IT security threats, which may pose risk to JSC systems and data.
TCR 1454 - Pressure Vessel System (PV/S) Compliance with NASA-STD-8719.17 FY13 Mitigation cost: \$1.65M	3 x 4	Given the condition that the current PV/S certification process is not in compliance with NASA-STD-8719.17 for the development of hazard and remaining safe life / integrity assessment; there is a possibility that PV/S's may have unknown conditions that could pose hazards/risks to JSC personnel and operations. Implementation schedule has been adjusted.
TCR 1626 - Reduction of CMO budget for Safety and Fire Protection FY13 Mitigation cost: \$400K	4 x 3	Given the condition of reduced funding in the areas of center institutional fire and safety services functions; there is a possibility that the Center's safety posture will be diminished in the areas of: personnel and property protection; as well as reduced compliance with OSHA, NASA and JSC safety requirements. Tasks have been adjusted to meet FY13 funding levels.
TCR 1779 Asbestos Containing Building Materials at JSC FY13 Mitigation cost: \$127K	3 x 4	Given the continued reduction of the budget associated with the "Management in Place" of Asbestos Containing Materials (ACM) and Asbestos Containing Building Materials (ACBM) and the significant reduction in the JSC Recapitalization Program; there is a possibility that the JSC Asbestos Program will be significantly impacted, potentially placing JSC personnel at risk of exposure and the Center in regulatory non-compliance. COD tasks will fund priority FY13 asbestos control tasks.
TCR 1694 - JSC/WSTF Funding to Support Institutional Pressure Vessel/System and WSTF Quality Certification Programs FY13 Mitigation cost: \$40K	2 x 3	Given the condition of reduced funding for JSC/WSTF Pressure Systems Management and Safety & Mission Assurance services provided by JSC Program Support; there is a possibility that there will be an increased risk of personnel injury, equipment, test hardware and facility damage. FY13 costs and resources have been distributed among system operators.
TCR 1786 JSC Health Programs FY13 Mitigation cost: \$350K	2 x 3	Given the continued cuts to CMO and CHS Health Program funding; there is a possibility that clinical (occupational surveillance, fitness for duty), preventative and urgent care, and the employee wellness programs will be ineffective or cease to exist. Tasks have been adjusted to meet FY13 funding levels.

Hazard Identification & Abatement



ARRA Construction activities completed with NO serious mishaps



Multi-Center NASA Team fulfills flawless PA-1 Test



Utility tunnel splice successfully accomplished pre-STS-125.



Leading Indicators “On the Horizon”

- Since 2006, JSC has been monitoring industry and government development of effective leading indicators.
- Examples of leading measure areas for high-risk systems include
 - Maintenance and system integrity
 - Operational qualifications
 - Challenges to safety systems and monitoring equipment
 - Communication and reporting systems
 - Accuracy of configuration management
 - Procedures and emergency plans
- Since 2009, focused assessments have been performed on high risk facilities to determine condition of risk controls.
- In 2012, the number of damage mishaps has been reduced ~75% for high-risk, prioritized facilities.

JPR 1700.1, Chapter 10.4 “Facility Baseline Documentation”

Buildings assessed using a checklist of 55 characteristics.

Checklist consists of 8 sections:

1	Configuration Control Documentation (7 questions)
2	General Operating Procedures (25 questions)
3	Detailed Procedures (1 questions)
4	Safety Documentation (5 questions)
5	Training Documentation (4 questions)
6	Preventive Maintenance (6 questions)
7	Other documentation (4 questions)
8	Maintaining Facility Baseline Documentation (3 questions)

General high-risk facility assessment guidance has been drafted for implementation in NPR 8715.3

Questions

- Questions?

Discussion



Gary DeMoss

Chief, Performance & Reliability Branch
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission



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Fluor



David Loyd

Chief, Safety & Test Operations Division
NASA Johnson Space Center

Key Points from Panelists

- If people were to remember only *one* thing about leading indicators, it should be _____.”

Wrap Up and Next Event

- Visit the SHLA Web site at nsc.nasa.gov/SHLA
 - Video of this presentation
 - Slides
 - Event summary
- Invite colleagues and other organizations to join us for our next event
 - “Assessing and Maintaining a Safety Culture”
 - September 19, 2013 at 1 p.m. EDT
 - Join the panel by contacting Mike Lipka at Michael.J.Lipka@nasa.gov or 440.962.3172
- [SHLA Event Survey](#)—we’d like to hear your feedback