“Safe and *Green*” at the National Aeronautics and Space Administration, NASA Johnson Space Center

American Industrial Hygiene Association Conference and Exposition

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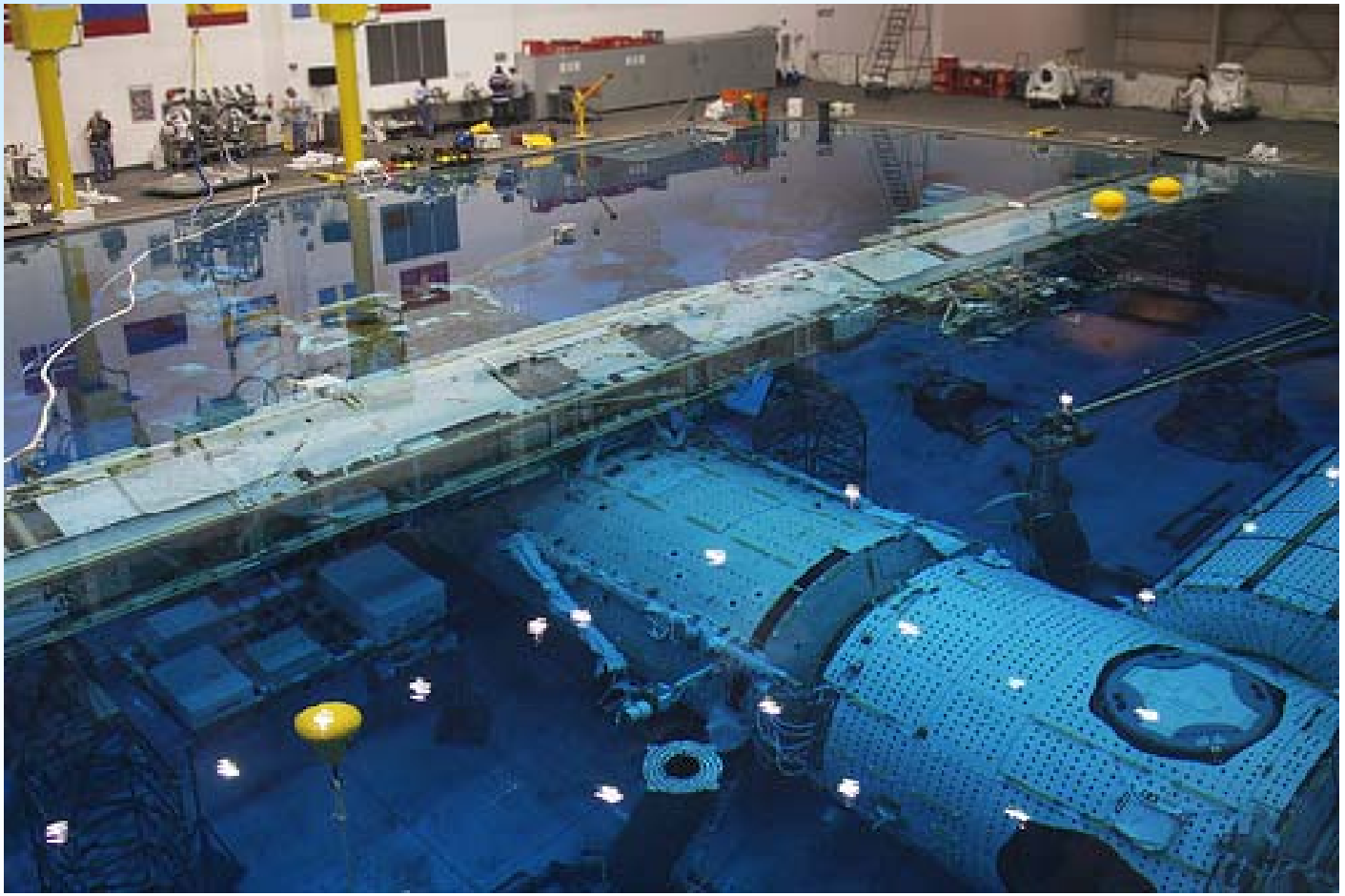
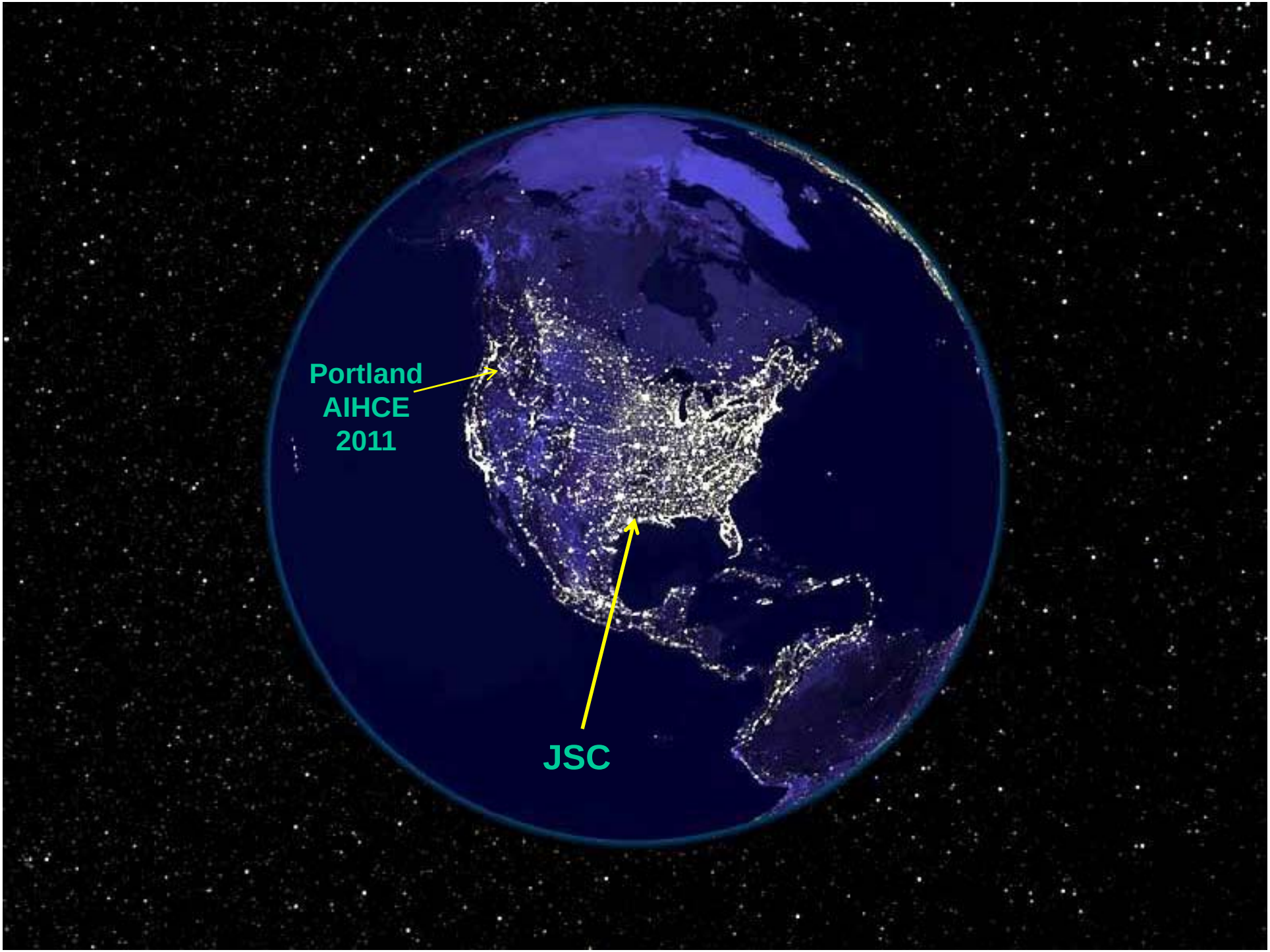
Consolidating an Agency LEED Requirement and a robust Construction Safety and Health process into a win-win scenario for workers and occupants in the JSC “Master Plan” Building Revitalization Program

Agenda

- History of the Construction of Facilities (COF) Safety and Health (S&H) process at JSC

- Review the NASA LEED mandate and how it works into the COF process.
- Show how our diverse stakeholder team works together and share some Case Studies and Lessons Learned




Portland
AIHCE
2011
JSC

National Aeronautics and Space Administration, NASA, Centers

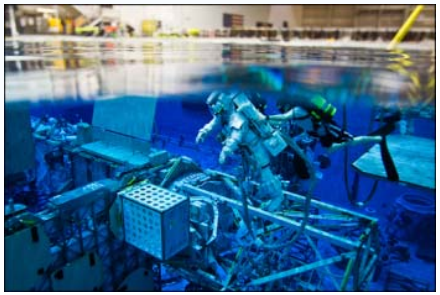
JSC Statistics

- South of Houston Texas “Clear Lake”
- 1600 acre main campus, 130+ buildings
- Main facility built in the late 1960’s and early 1970’s
- Approximately 10,000 team members on-site
- Shuttle (retiring and International Space Station (ISS)Programs
- Home Center for the Astronaut Corp
- Engineering Labs and Test Facilities
- Curation of Lunar and other Planetary Materials


NASA
905
United States

JSC Statistics

- Occupational Safety and Health Administration (OSHA) Voluntary Protection Program (VPP) Star Site (since 1999)
- VPP Star Certification for ~20 Team Contractors

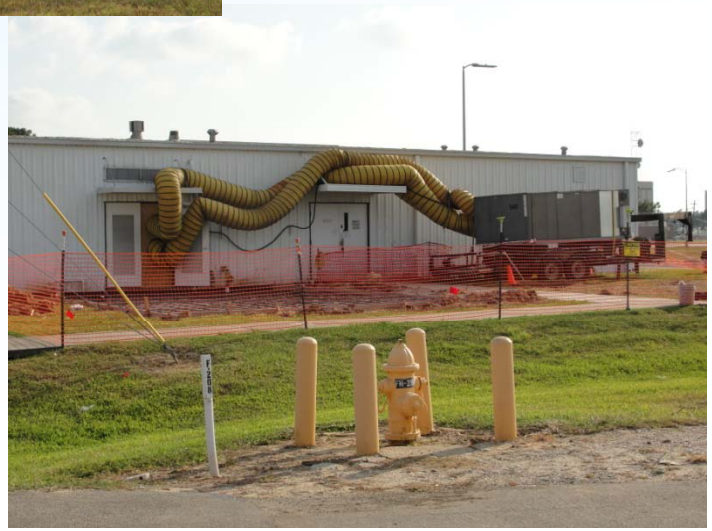


Facilities Operations

- JSC “Mall” buildings, most built in the late 60’s and 70’s, are in need of significant upgrades, roofs, air handlers, exterior , inefficient energy systems
- Several thousand employees housed off-site.

Facilities Operations

- Many Temporary Buildings are at risk from hurricanes.



Facilities Operations

- Center Operations Directorate has developed a “Master Plan” intended to meet the current and future facility needs of JSC programs. Construction will primarily be “Renovate and Refurbish”.
- Included in this 20 year plan is a stand alone building designed to house employee organizations displaced as their building is under renovation

Building 20

Defining Event

- 2002 significant construction mishap resulted in a review of the JSC Safety and Health Construction process.
- Findings resulted in an overhaul of how S&H is incorporated into the Construction of Facilities (COF) process.

Finding

- **Existing Culture**
  - COD Construction safety and health effectiveness is diminished by inconsistent Government stakeholder involvement. This negatively influences construction contractor's management commitment to place emphasis on safety and health, which in turn allows default to unsafe work practices.

Finding

- **Desired COD Construction S&H Culture**
  - COD construction stakeholders consistently apply the same safety and health values and expectations to construction contractors as JSC does to our entire JSC team.

Corrective Actions

- Brought together a team with experience in Project Management, Contract Procurement & Administration, Construction Management & Inspection, and Construction Safety & Health (S&H) with the purpose to draft:
  - A new Johnson Space Center (JSC) S&H contract procurement solicitation for use on all “Best Value” construction contracts.
  - A new JSC Construction S&H Master Specification for use on all construction contracts.
- The Team products were to combine all S&H requirements Federal Acquisition Regulations (FAR), NASA S&H FAR Supplements & Policy, JSC S&H Policy, Requirements & Guidelines, and OSHA Policy & Requirements into one unified document. Contractor S&H past performance was an important factor.
- Stakeholder involvement required from PER through construction and final building acceptance by the Government.

Follow up teams : Summary

ZERO Incidents

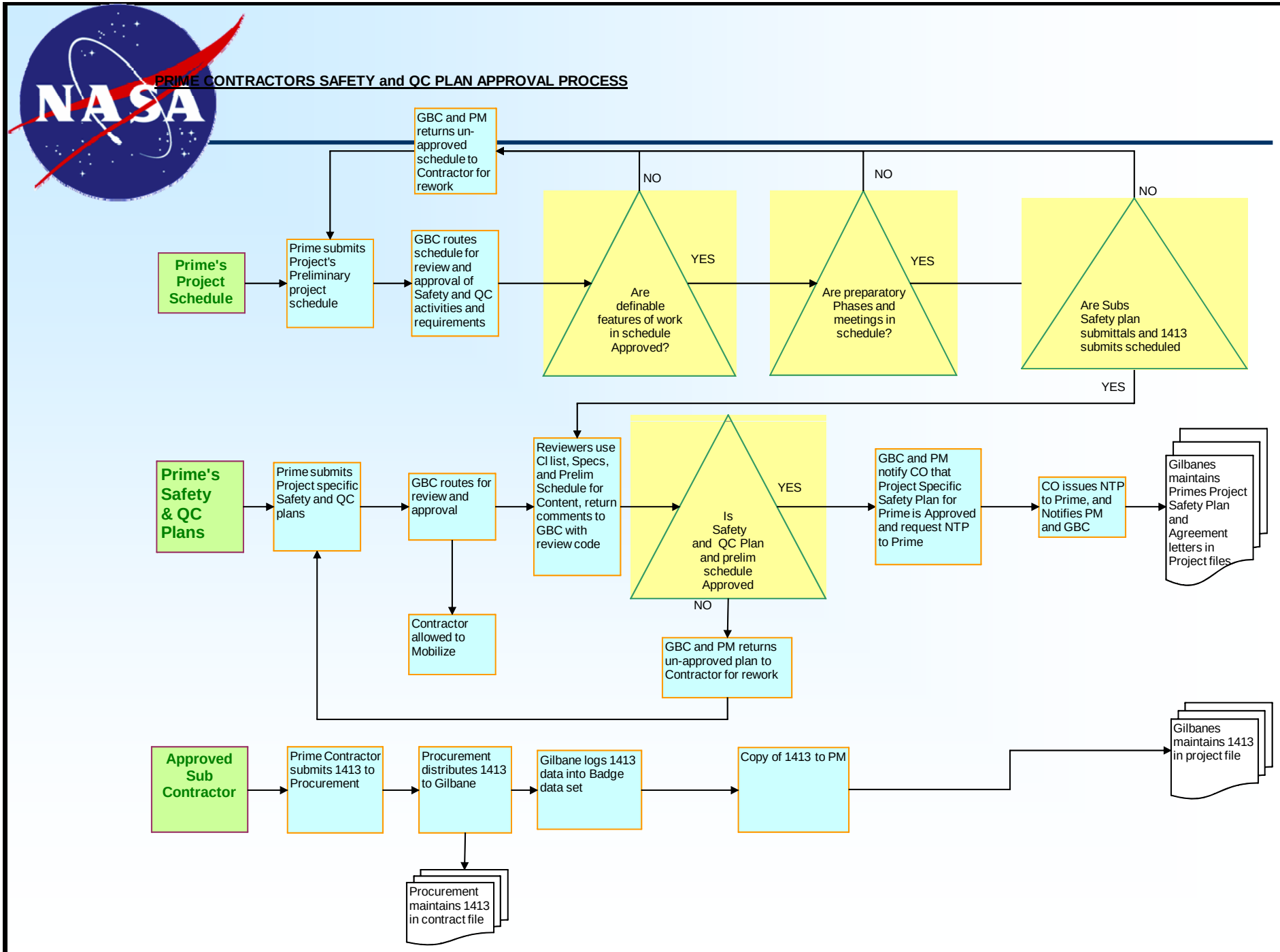
- Implemented new S&H specification for all CoF Construction work.
- Mandatory S&H training prior to Site Access for all CoF construction Personnel, training level dependent on duties
- Utilizes Houston Area Safety Council (HASC) for the Mandatory Training and testing
- Utilized findings from Construction Industry Institute Study funded by NASA HQ's

Construction Industry Institute®

COD is the foundation for mission success.

houston area safety council hasc

VPP
Voluntary Protection Programs
An OSHA Cooperative Program


PRIME CONTRACTORS SAFETY and QC PLAN APPROVAL PROCESS
GBC and PM returns un-approved schedule to Contractor for rework
NO
NO
NO
Prime's Project Schedule
Prime submits Project's Preliminary project schedule
GBC routes schedule for review and approval of Safety and QC activities and requirements
Are definable features of work in schedule Approved?
YES
Are preparatory Phases and meetings in schedule?
YES
Are Subs Safety plan submittals and 1413 submits scheduled
YES
Prime's Safety & QC Plans
Prime submits Project specific Safety and QC plans
GBC routes for review and approval
Reviewers use CI list, Specs, and Prelim Schedule for Content, return comments to GBC with review code
Is Safety and QC Plan and prelim schedule Approved
YES
NO
GBC and PM notify CO that Project Specific Safety Plan for Prime is Approved and request NTP to Prime
CO issues NTP to Prime, and Notifies PM and GBC
Gilbanes maintains Primes Project Safety Plan and Agreement letters in Project files
Contractor allowed to Mobilize
GBC and PM returns un-approved plan to Contractor for rework
Approved Sub Contractor
Prime Contractor submits 1413 to Procurement
Procurement distributes 1413 to Gilbane
Gilbane logs 1413 data into Badge data set
Copy of 1413 to PM
Gilbanes maintains 1413 in project file
Procurement maintains 1413 in contract file


CAUTION
LIQUID
NITROGEN

Current Process

- NASA NPR (NASA Procedural Requirement) 8820.2F Facility Project Requirements was revised in 2008:
  - Mandates HSE involvement
  - Best Practices Expectation for Construction S&H
    - "Making Zero Incidents a Reality"
- JSC Specific Process Compliments NPR

NASA LEED Mandate

- **NASA Procedural Requirement NPR 8820.2F Facility Project Requirements, January 2008**

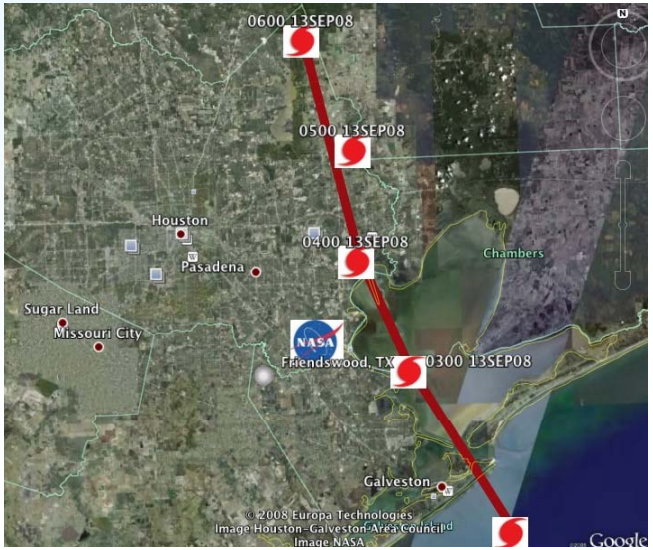
- **Sustainability- NASA has adopted the US Green Building Councils Leadership in Energy and Environmental Design (LEED) as its performance measure for sustainable development.**
- **All building and renovation projects awarded after October 1, 2005 shall meet the minimum LEED Silver ratings.**

- Team
  - NASA Center Operations , A/E Firm, Engineering Support Services
  - Occupational Health, Safety, Environmental
  - Procurement
- Tools
  - PtD Prevention Through Design “Concepts”
  - Buy Quiet, Quiet by Design Requirement
  - CII benchmarking
  - Lessons Learned
  - Case Studies
  - HASC Teaming
  - Strong HSE network
  - Green Building Council

- Focal point for all construction S&H issues and the NASA Project Manager and the Contract Engineering Support Services Project Lead, who is also the LEED Accredited Professional.
- ….One stop shopping for all Health, Safety and Environmental issues.

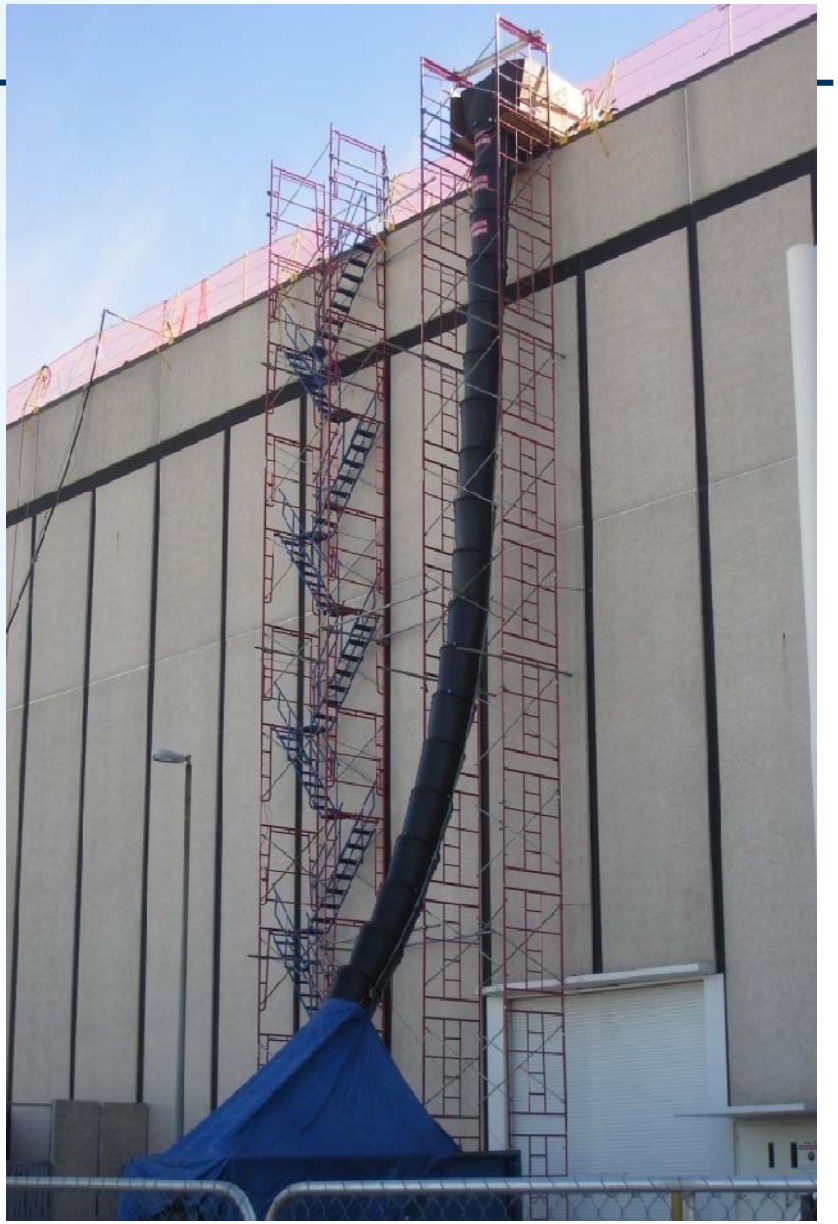
Since Then We have Gotten a lot of Practice

- Several Hurricane Close Calls, and then a Direct hit from “IKE”



- American Re-Investment and Recovery Act ARRA/ Stimulus
  - We received a some stimulus funds that allowed us to complete repairs on many of the hurricane damaged roofs.

- Construction of Facilities (COF) - Plus the ongoing work on buildings in the “Pipeline” for the JSC Master Plan




Refurbishment of Building 2 North and
Roof Replacement Building 2 North and South
DANGER
CONSTRUCTION AREA
CAUTION
NOTICE
AUTHORIZED PERSONNEL ONLY


Building 24 - FY08 Upgrade To
Central Heating And Cooling Plant
OWNER:
NASA
Engineer:
Burns & McDonnell Engineering Co., Inc.
FMOD:
Gilbane Building Company
GC:
Sauer, Inc.
Gilbane
SAUER
• Boiler Feedwater Pumps 1,2,3 and 4
• Condensate Transfer Pumps 1,2,3 and 4
• Condensate Tanks COT-24-1
• Deaerator DA-24-3
• Chilled Water Expansion Tank CHWCT-4
• Chilled Water Makeup Tank CHWMT-1


Building 29 - Crew Exploration Vehicle
Avionics Integration Laboratory (CAIL)
Gilbane
SAUER


"MAKE SAFETY
YOUR BUSINESS"
BE ACCIDENT FREE IN '63

JSC LEED Facilities

- 27 Certified (Built prior to the LEED Silver requirements)
- 207A - Silver
- 265 - Gold
- 2N - Gold

- 20 - Platinum (NASA's first ever LEED Platinum building)
- 26 - Gold
- 29 - Silver (waiting for the final certification)
- 12 - Striving for Gold (In Progress)

No “Live” roofs, yet.. One possibility in the works..


U.S. GREEN BUILDING COUNCIL
LEED GOL
2010


LEED-NC CERTIFIED 2009
U.S. GREEN BUILDING COUNCIL


U.S. GREEN BUILDING COUNCIL
LEED PLATINUM
2010


2010


26

LEED Lesson Learned

- From JSC Construction Management

  - Generally Speaking- “Green” construction is not significantly different… Build to the design, Material Procurement was difficult at first, however the supply network to meet the specs is growing….However, we have not constructed a “living” roof, yet..
  - Materials - Low VOC requirements have translated into a noticeably less “toxic” smelling building during construction. Glues, Adhesives, Paints, Texturing, Flooring, etc..
  - Material Submittals have to go through 3 reviews- Meet Quality Specs, Meet LEED Specs, Meet S&H Specs..
  - Incorporating S&H into the LEED criteria viewed as a positive benefit by our Engineering Support Services Team. Aligns closely with our JSC values to sustainability and worker and occupant protection…


2N PUBLIC AFFAIRS
NASA
OFFICE OF COMMUNICATION & PUBLIC AFFAIRS
NASA
OFFICE OF COMMUNICATION & PUBLIC AFFAIRS

During Construction

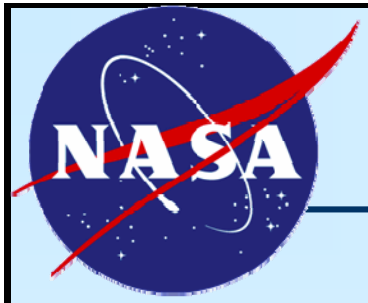
- Submittal and Material Safety Data Sheet MSDS Review-
  - Three levels of product review- Quality Review, Green Review, S&H review-
    - Requires a good HSE professional to tease out any potential hazards to workers in some of the “Green”, or labeled “Green” Products.
  - Glue – MSDS for common glue “VOC not determined”, looked green to the contractor, Hazardous Component- MDI?? What is that…
- Cisterns (in ground) for water collection and redistribution- Confined Space issues
- Sky Light and light transmitting roof materials- well know hazards

Occupancy

- Sky light Guarding- During construction and afterward- well recognized Hazard
- Energy Conservation-
  - Re-circulating hot water system- colonized by legionella, facility had showers. “Pasteurized” the system and then sampled. Took several cycles to eliminate the legionella.
  - Lighting- late night operations
- LEED requirement for showers… Potential for legionella, aersolization when used by employees.. Need to periodically sample???
- Automatic Outside Air systems- CO2 monitor in the air handler, opens outside air when CO2 “trigger level” is reached, Usually 1000PPM, must be careful, especially in Texas, that the Outside Air is PTOA, (Pre-Treated
- Glare
- Temperature sometimes harder to maintain

- We fully embrace the concept of adding construction S&H to LEED certification criteria, consider it a win-win benefit.


Thank You



BACK UP


NASA
NOV 3 2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01/17/2008 15:24

- Construction focus
  - Building Age JSC Revitalization
  - Hurricanes (IKE)
  - Stimulus Lots of Roof

Building 20

Verde Veinte V^2

Overview

•Three story, approximately 83,000 square feet.

•Building 20 was designed with “less is more”. Only applied material if materials was necessary.

• Project is registered with United States Green Building Council (USGBC) as a Leadership in Energy and Environmental Design (LEED) “Gold” rating but was upgraded to “Platinum”.

•Designed by Hellmuth, Obata, and Kassabaum, Inc.

•Provides for a permanent location for 120 employees on the third floor and can house 400 employees on the other two floors.

•Office Building project supports the building refurbishment program to provide “flex” space for employees temporarily relocated due to refurbishment of their building.

Improving Acoustics

•Ceiling is exposed concrete with ceiling clouds

•The clouds help improve the acoustics of the open office and provide a surface for the indirect lighting to reflect the light back into the work area

Preserving Our Forests

•The ‘rapidly renewable’ material Bamboo is utilized throughout the building’s cabinetry and millwork.

•90% of the wood used in the building is Forest Stewardship Council (FSC) approved showing that they were harvested in a responsible manner that minimized the impact on our forests

•Almost 20% of the materials used on this job were manufactured within 500 miles of JSC, stimulating local business and minimizing fuel consumed in shipping

Reducing Water

•Plumbing fixtures were selected based on their water savings potential through the use of waterless urinals, dual flush flushometers for the water closets and 0.5 GPM electronic faucets with controls to operate in 10 second durations

•Water efficient landscaping uses no potable water, irrigation water is captured from the air handlers condensate system

Reducing Energy Consumption

- Approximately 90% of the floor area in the building will have access to natural light and a view of the world outside

- Solar shading devices engineered to not only provide more daylight, done so to minimize glare and discomfort when working at computer monitors

- Building orientation reduces area facing the sun directly during its most intense periods; thereby reducing heat gain and glare

Reducing Energy Consumption

- **Glass is high efficiency, great light transmittance and coated to reduce heat gain. More glass reducing the need for artificial lighting.**

- **Lighting is automatic and will increase and decrease in intensity based on the amount of daylight harvested through the glass and via the solar shading devices.**

- **Highly energy efficient envelope.**

  - **Enough energy is saved to power approximately 55 average sized homes annually.**

Reducing Energy Consumption

- The building utilizes a solar water heating system that transmits heat generated from roof mounted solar panels into the building's hot water system, reducing the buildings foreign energy consumption.

- Roof coating that reflects the sun heat and energy back into the atmosphere.

Reducing Energy Consumption

- Bike Storage and Shower/Changing rooms. This encourages riding bicycles to conserve energy.

- CO_2 monitors in the HVAC systems that will automatically introduce outdoor air when CO_2 levels are high, thereby making the space better for working and more efficient in energy usage when not occupied or occupied with fewer individuals.

- Supply air temperature reset-improves efficiency by using the air and energy actually needed.

- High efficiency filters provides better air for occupants and keeps the HVAC system cleaner longer

Cool Features

- Each office has an eraser board built into the wall

- Entry mats at the two main entrances have a cavity below them that capture particles from the shoes of incoming occupants, minimizing the particles floating around the building

Recycle

- **Approximately 95% of the waste generated by the construction of this project has been recycled.**

- **Permanent recycling Receptacles are centrally located to encourage occupant participation.**

- **Over 25% of the materials used in this building are recycled materials.**

- **Some items used that contain recycled materials are:**

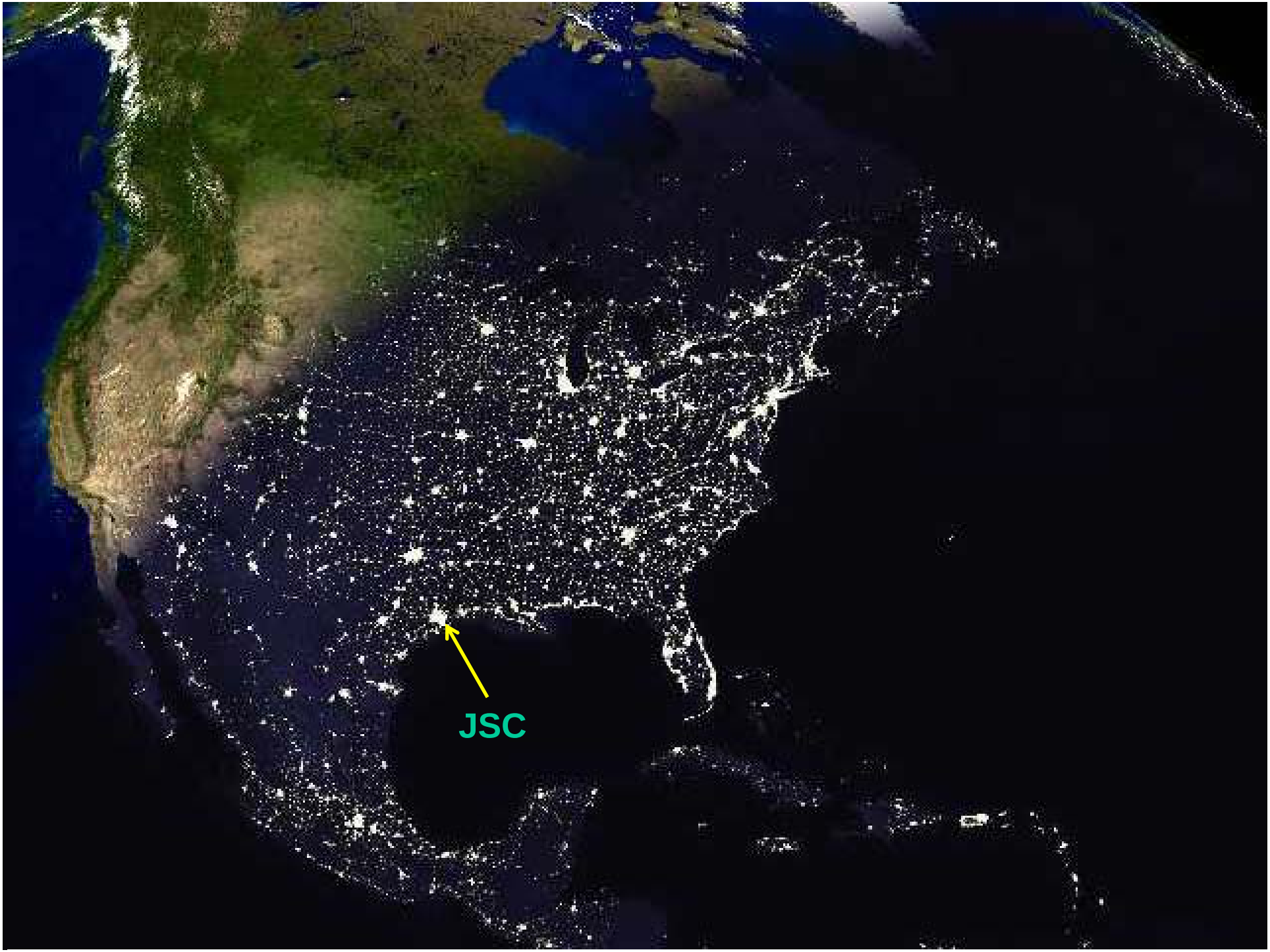
  - **Ceiling tiles**
  - **Countertops (recycled glass)**
  - **Reinforcing steel and structural steel**
  - **Concrete**

Current Status

- The project has a tentative completion date of December 18, 2009.

- Grand opening is scheduled for January 7, 2010.

- Occupant move-in is scheduled for January 11, 2010.


JSC

LEED for New Construction v2.2
Registered Project Checklist

Project Name:	NASA Bldg. 12 Refurb
Project Address:	JSC Houston, TX
Certification Goal:	**Gold minimum; Platinum if feasible**
Certification Estimate:	**Post-Bid Reassessment for possible Platinum Certication**

Yes	?	No	Sustainable Sites (26)	14 Points	Comments
Prereq 1			**Construction Activity Pollution Prevention**	Required	
1			**Site Selection**	1	
	1		**Development Density & Community Connectivity**	1	Will evaluate if project can meet Development Density option
	1		**Brownfield Redevelopment**	1	Need to confirm with Gilbane if asbestos abatement has been approved on other LEED projects
	1		**Alternative Transportation**, Public Transportation Access	1	Per J.White, shuttle bus exist on campus. Verify stop location proximity to B12
1			**Alternative Transportation**, Bicycle Storage & Changing Rooms	1	
1			**Alternative Transportation**, Low-Emitting & Fuel-Efficient Vehicles	1	
1			**Alternative Transportation**, Parking Capacity	1	
	1		**Site Development,** Protect or Restore Habitat	1	If project earns SSc2, the amount of open space needed is only 20% including green roof
1			**Site Development,** Maximize Open Space	1	
	1		**Stormwater Design,** Quantity Control	1	Will need to review calcs again - very difficult to achieve (need to reduce stormwater rate & quantity 25% from current levels)
		1	**Stormwater Design,** Quality Control	1	Not feasible for project site
1			**Heat Island Effect,** Non-Roof	1	
1			**Heat Island Effect,** Roof	1	
	1		**Light Pollution Reduction**	1	Point is achievable if JSC approves replacing existing 250w metal halide light poles to 88w LED pole lights (or equivalent)

Yes	?	No	Water Efficiency (7%)	5 Points	Comments
1			**Water Efficient Landscaping**, Reduce by 50%	1	
1			**Water Efficient Landscaping**, No Potable Use or No Irrigation	1	
		1	**Innovative Wastewater Technologies**	1	Not feasible to project type or site
1			**Water Use Reduction**, 20% Reduction	1	
1			**Water Use Reduction**, 30% Reduction	1	

Yes	?	No	Energy & Atmosphere (35%)	17 Points	Comments
Prereq 1			**Fundamental Commissioning of the Building Energy Systems**	Required	
Prereq 2			**Minimum Energy Performance**	Required	
Prereq 3			**Fundamental Refrigerant Management**	Required	
4	4	2	**Optimize Energy Performance**	1 to 10	Need to review and assess energy efficiency measures; will re-evaluate existing energy model for adjustments that can be made based on existing design
			1 3.5% New Buildings or 3.5% Existing Building Renovations		
			2 7% New Buildings or 7% Existing Building Renovations		
			3 10.5% New Buildings or 10.5% Existing Building Renovations		
			4 14% New Buildings or 14% Existing Building Renovations		
			5 17.5% New Buildings or 17.5% Existing Building Renovations		
			6 21% New Buildings or 21% Existing Building Renovations		
			7 24.5% New Buildings or 24.5% Existing Building Renovations		
			8 28% New Buildings or 28% Existing Building Renovations		
			9 31.5% New Buildings or 31.5% Existing Building Renovations		
			10 35% New Buildings or 35% Existing Building Renovations		
	1	2	**On-Site Renewable Energy**	1 to 3	Need to review current features to ensure 2.5% and assess cost & design implications of additions to reach 7.5%
			1 2.5% Renewable Energy		
			2 5% Renewable Energy		
			3 7.5% Renewable Energy		
1			**Enhanced Commissioning**	1	Extremely difficult per program and costs
1			**Enhanced Refrigerant Management**	1	Not achievable based on existing cooling plant
1			**Measurement & Verification**	1	
1			**Green Power**	1	

Yes	?	No	Materials & Resources (14%)	13 Points	Comments
Prereq 1			**Storage & Collection of Recyclables**	Required	
1			**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1	
	1		**Building Reuse**, Maintain 95% of Existing Walls, Floors & Roof	1	Need to review calculations to determine if this amount of reuse is in the design
	1		**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1	Very unlikely due to replacement of old, substandard and hazardous interior materials by design
1			**Construction Waste Management**, Divert 50% from Disposal	1	
1			**Construction Waste Management**, Divert 75% from Disposal	1	
	1		**Materials Reuse**, 5%	1	Need to verify realined materials amount and viability for recognition
	1		**Materials Reuse**,10%	1	Difficult to achieve per project type
1			**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1	
1			**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1	
1			**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1	
1			**Regional Materials**, 20% Extracted, Processed & Manufactured Regionally	1	
	1		**Rapidly Renewable Materials**	1	Difficult to achieve per approved design. Need to do cost calculations to determine the amount of materials needed to meet 2.5% threshold
1			**Certified Wood**	1	

Yes	?	No	Indoor Environmental Quality (21%)	15 Points	Comments
Prereq 1			**Minimum IAQ Performance**	Required	
Prereq 2			**Environmental Tobacco Smoke** (ETS) **Control**	Required	
1			**Outdoor Air Delivery Monitoring**	1	
		1	**Increased Ventilation**	1	Do not suggest attempting this credit in this climate. Will decrease energy efficiency.
1			**Construction IAQ Management Plan**, During Construction	1	
1			**Construction IAQ Management Plan**, Before Occupancy	1	
1			**Low-Emitting Materials**, Adhesives & Sealants	1	
1			**Low-Emitting Materials**, Paints & Coatings	1	
1			**Low-Emitting Materials**, Carpet Systems	1	
1			**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1	
1			**Indoor Chemical & Pollutant Source Control**	1	
1			**Controllability of Systems**, Lighting	1	
	1		**Controllability of Systems**, Thermal Comfort	1	Quick review of occupied office spaces indicates possible point with additional T-stats and some fan units at each floor
1			**Thermal Comfort**, Design	1	
1			**Thermal Comfort**, Verification	1	
	1		**Daylight & Views**, Daylight 75% of Spaces	1	Will use daylight software to determine if this credit can be achieved.
1			**Daylight & Views**, Views for 90% of Spaces	1	

Yes	?	No	Innovation & Design Process (7%)	5 Points	Comments
1			**Innovation in Design**: UV Lights in HVAC + 1 yr. IAQ testing	1	Need to confirm with Gilbane this can be achieved.
1			**Innovation in Design**: Exemp. Perform MR 2 Constr Waste Mgt	1	
1			**Innovation in Design**: Exemp. Perform. WEc3 Water Use Reduction	1	
1			**Innovation in Design**: Green Education	1	
1			**LEED® Accredited Professional**	1	

Yes	?	No	Project Totals (pre-certification estimates)	69 Points
42	14	13		Must ensure 60-65% of 16 maybe points are achieved for platinum to succeed

Certified: 26-32 points, **Silver:** 33-38 points, **Gold:** 39-51 points, **Platinum:** 52-69 points

Results

- **What has been done in COD to improve Construction Safety:**
- COD chartered a Team to Improve construction contractor S&H
  - Low Hanging fruit- Owner involvement
    - S&H orientation was implemented Construction Contractors before Access to the Center 7 AM each morning with a PM
    - Implemented requirement for project specific S&H plans, and review, prior to Notice To Proceed with construction work
    - Five onsite MEI construction Safety professionals added for QA of safety at construction sites
    - Implemented trending of safety and health violations at construction sites, and follow-up proactive intervention with contractors
    - Renewed training for all Project Managers

- Charted sub-team to diagnose problems and improve configuration control of facility: designs, documentation, and procedures.
- Implemented joint S&H meetings with Construction Contractors and JSC personnel to improve communications with active construction contractors
- Chartered sub-team to review outage process and utility procedure process to improve and control execution of procedures.
- Implemented project technical peer reviews
- URR's for critical facilities modifications to ensure system engineering
- Follow up team actions
- Implemented a new Johnson Space Center (JSC) S&H contract procurement solicitation for use on all "Best Value" construction
- combined all S&H requirements Federal Acquisition Regulations (FAR), NASA S&H FAR Supplements & Policy, JSC S&H Policy, Requirements & Guidelines, and OSHA Policy & Requirements into one unified document. Decide what had the greatest importance and say it twice:

➢ **Clarify the safety references**

➢ **Expand on the salient features in a Safety & Health Technical Provision**

- implemented the applicable results of the research study performed by the Construction Industry Institute address the Owners Involvement In Construction Safety:
-
- Set a TRIR requirement for construction contractor selection.
- Set an EMR requirement for construction contractor selection.
- Set a DART requirement for construction contractor selection

Process

- **Clarify the safety references**
- **Expand on the salient features in a Safety & Health Technical Provision**

- The Team products were to implement the applicable results of the research study performed by the Construction Industry Institute address the Owners Involvement In Construction Safety:

- **Contractor's safety performance makes a difference in contract award.**

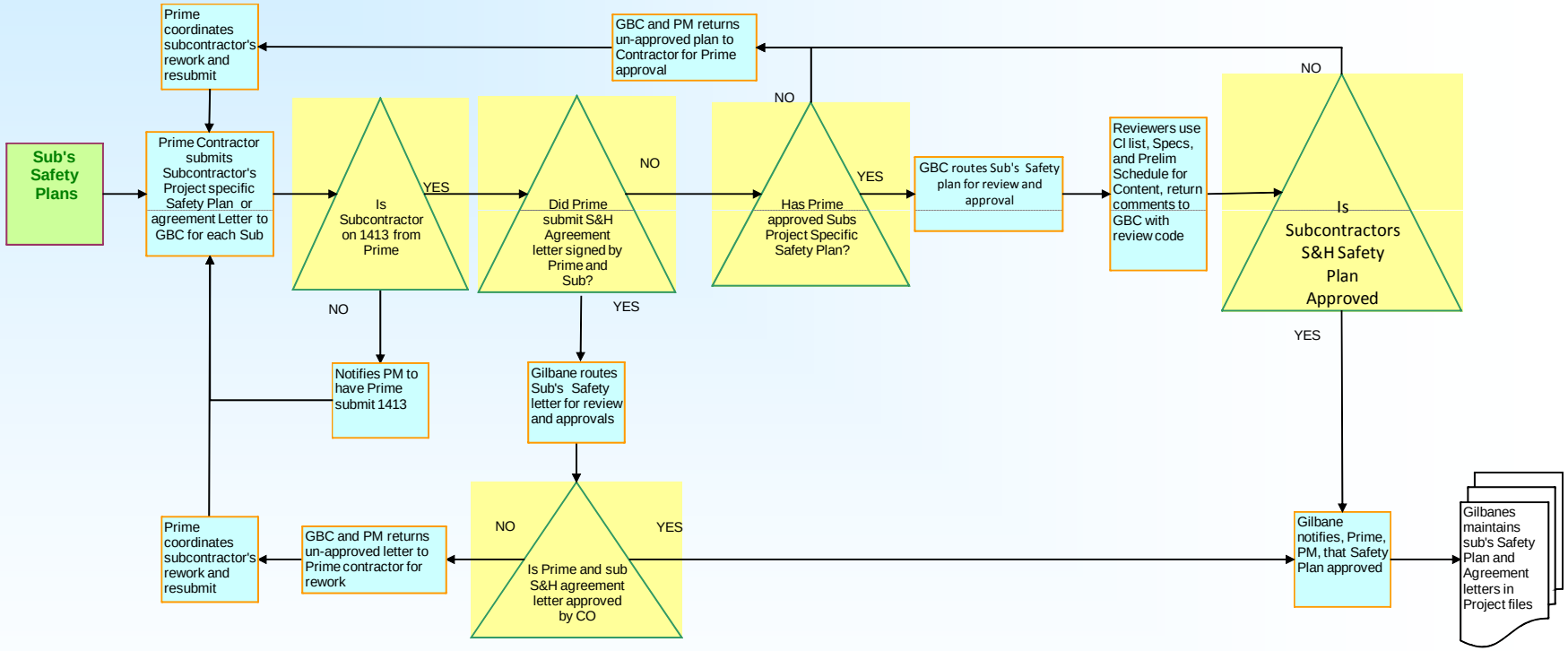
Set a TRIR requirement for construction contractor selection.

Set an EMR requirement for construction contractor selection.

Set a DART requirement for construction contractor selection.

- Specify and Review the qualification of the Contractor Safety Staff.
- Require full time safety representatives on the project.
- Require submission and review of S&H experience of Safety Staff.
- Set the minimum standard for the Site Specific S&H Plan. ()
- Require the Contractor to submit a S&H Policy signed by the CEO.
- Require a minimum specified amount of S&H training for the construction workers and supervisors.
- Put a greater emphasis on prevention and preparation with pre-task S&H planning.
- Require the contractor to implement a substance abuse program.
- Furnish and maintain injury statistics.

SUBCONTRACTOR S&H PLAN and 1413



Communicate, Communicate