AVOID VERBAL ORDERS

TO: Distribution September 19, 2001

FROM: PH-P1/M. Glenn

SUBJECT: 9/13/01 KSC Lifting Devices and Equipment Committee Meeting Minutes

A KSC Lifting Devices and Equipment (LDE) Committee meeting was held on September 13, 2001, at 1:00 pm, in the Operations Support Building, K6-1096, Room 5308.

Meeting attendees were as follows:

Name	Organization and Function	Mail Stop
Malcolm Glenn	NASA S&MA	PH-P1
Jim Blake	USA HEE	USK-547
Susan Thai	USA HEE	USK-547
Don Lamond	USA HE Ops	USK-131
Bill Carew	NASA HE Engr	PH-J
Walt Szczepanik	USA GSDE	USK-127
Stephen Koca	USA System Engr	USK-353
Brian Graf	NASA Ground Systems	UB-C3
Ed McKnight	Boeing Safety	721S-S215
Sam Rivera	Boeing SRM	7210-C355
Jack Barnette	USA S&MA	USK-291
Larry Jones	NASA System Engr	PH-J
Dick Bauman	Boeing Facility Design	7210-E35
Mike Mullins	USA GSE Engr	USK-708
John Bisbey	USA SRBE GSE Engr	USK-887

Meeting agenda items were as follows:

1. NASA lifting standard update.
2. KSC LDE Committee Charter.
3. KMI 6730.3 update.
4. KSC nonload test slings.
5. Safety variances.
6. Mishaps.
7. Other topics.

Details of the meeting agenda items are as follows:

1. NASA lifting standard update. The latest draft of the NASA Standard for Lifting Devices and Equipment, NASA-STD-8719.9, dated September 2001, was sent out for comment on 9/7/01. The September 2001 draft of the lifting standard will be the last chance for comments. If you have comments, submit them to me by 9/28/01.

   If you know of impacts, potential non-compliances, safety variance conditions or have questions regarding the new lifting standard, please contact me. To date, probable permanent safety variance candidates to the new lifting standard are the orbiter portable jacks and jacks used in the SSPF to support flight hardware. These particular safety variances involve the non-performance of a periodic load test, which the new standard will require, because of the complicated and difficult nature of such a test for this equipment. It is intended to write these safety variances once the new lifting standard is released/approved.

2. KSC LDE Committee Charter. Copies of the KSC LDE Committee Charter were handed out. A copy of the Charter is included as a part of these minutes. The Charter more formalizes the KSC LDE Committee.

3. KMI 6730.3. KMI 6730.3, Examination/Licensing of KSC Special and Heavy Equipment or Facility Cranes/Hoists Operators has been updated, to reflect KSC 2000 organization changes; i.e., the OPR was changed from EC to PH.

4. KSC Nonload Test Slings. We are starting to add items to the KSC List of Nonload Test Slings like shackles and other rigging equipment. Contact me if you have questions about what can be on this list and/or if you think there is something to add to the list. We recently changed this list from the "KSC List of Nonload Test Structural Slings" to the "KSC List of Nonload Test Slings" to accommodate such items as shackles and the like.

5. Safety Variances. Safety variance 2001039, a permanent variance to discontinue periodic load testing of utility substation hoists in the LC-39 area, was discussed. A copy of the variance is included as a part of these minutes.

6. Mishaps. A couple of mobile crane mishaps, one which occurred in Georgia and another which occurred at the DOE Nevada Test Site were discussed. Summaries of these mishaps are included as a part of these minutes. These mishaps provide valuable lessons learned. Two other items, regarding mobile crane hardware failures, were also discussed. One of the mobile crane failures occurred at CCAFS. If you have questions about the CCAFS failure, contact Henry (Hank) Brown with SGS Safety and Health at 853-7086. Thanks Hank. Summaries of these items are also included as a part of these minutes.

7. Other Topics. With the new lifting standard, the designation of an installation Lifting Devices and Equipment Manager (LDEM) alternate will be required. Larry Jones, PH-J, is the alternate KSC LDEM . If I am not available and you need assistance, contact Larry. Also, if I am out of town or on travel or otherwise not available for an extended period of time, I will let you know and refer you to Larry.

Contact me if you have any questions or need assistance with something. Thanks.

Original signed by
Malcolm Glenn

KSC Councils, Boards, and Working Groups
Charter Form

Name and/or Project Title	**KSC Lifting Devices and Equipment Committee**
Charter	• Ensure requirements of NASA-STD-8719.9, NASA Standard for Lifting Devices and Equipment, are understood and applied across program lines and in all facets of KSC functional control areas, including Government and contractor organizations. • Provide forum for interchange of information. • Review lifting devices and equipment and standards variances and make recommendations. The Chair may do this alone or on input from committee members. • Recommend training courses. • Draft Center Directives for Center approval. • Perform assessments when requested by Center Management.
Membership	Chair: KSC Lifting Devices and Equipment Manager (PH) Members: Representatives of major KSC and contractor organizations (TA, QA, UB, VA, YA, PH, SFOC, PGOC (CAP), JBOSC, ELVIS, EDC)
Period of Performance	Start Date: 12/88 End Date: Ongoing
Deliverables	• Biannual report to the KSC Safety & Health Council • Draft policies and procedures
Meeting Guidelines	1. Meeting Frequency: biannually or additional meetings as required 2. Length of Appointment: Chair–permanent (PH) 3. Minutes/Agenda Requirements: Chair responsible for minutes. Electronic minutes mailed to QA-B/CI Specialist.
Reporting To (and other sponsors, if required)	Michael E. Watrous David A. King, Director Shuttle Processing
KSC Roadmap Objective and/or Strategy	Guiding Principle: Safety and Health First Objective: Strengthen KSC's safety, health, security and environmental stewardship.
KDP Reference, if applicable	NSS/GO-1740.9 KHB 1710.2 KMI 6730.3

KSC Lifting Devices and Equipment Committee Charter

Concurrence:

for 8/15/01
John J. Talone, Jr. Date
Director of International Space Station/Payload Processing

for P. Wayne Bodge 8/15/01
Stephen M. Francois Date
Manager, ELV and Payload Carriers Programs

for M. T. Simmons 8/15/01
J. Chris Fairey Date
Director of Spaceport Services

8/15/01
James R. Heald Date
Director of Spaceport Engineering and Technology

for C. Montgomery 8-16-01
Shannon D. Bartell Date
Director of Safety, Health & Independent Assessment

Safety Variance Request

1. Request No. NASA 2001039

2. Duration FROM	TO	Permanent Variance	3. Permanent Document Change Required?
06-29-2001		☑	☐ Yes ☑ No

4. Requesting Organization
PH-P1

5. Document and Title	Section
NSS/GO-1740.9, NASA Safety Standard for Lifting Devices and Equipment	**NSS/GO-1740.9, paragraph 402b**

6. Facility/Flight Hardware/GSE Affected
Utility Substation Hoists

7. Is TOP Change Required?	Specify Top
☐ Yes ☑ No	

8. Requirement Description
See Attachment

9. Impact if Not Approved
See Attachment

10. Rationale for Approval
See Attachment

11. Statement of Compliance with Higher Level Requirements
This variance does not violate higher level requirements.

ORGANIZATION	NAME	SIGNATURE	PHONE	MAIL CODE	DATE
12. Requestor	M. GLENN	M. Glenn	1-4128	PH-P1	6/25/
13. Concurrence					
Cont. System Eng.	C. Freeman		1-4457	USK 598	6/25/0
Requesting Org. Mgr.	56-50	NEIL BUCHANAN	1-7961	USK 275	6/26/
Requesting Org. Dir.	J.A. Abbey	Jimmy A. Alcton der	1-2156	USK 042	6/26/0
Saf. & Rel. Eng. Mgr.	R. E. HARVEY	Gilbert Harvey	1-0506	USK-291	6/26/
USA CHIEF ENGR	K. S. HERMAN		1-3568	USK-321	6/26/0
Center Director	Roy D. Bridges, Jr.		7-3333	KSC/AA	6/29/
KSC Chief Safety Officer	BERT GARRIDO		7-1982	QA	6/27
14. NASA Approval:					
System Eng.	RICK BLACKWELDER		1-3258	PH-J	6/26/
~~NTD~~ Chief Engineer	Charles Abner		1-3800	PH-A	6/26/
Safety OPR	M. GLENN	M. Glenn	1-4128	PH-P1	6/26/
Safety Dir.	W. HIGGINS		1-7901	PH-P	6/26/0

8. Requirement Description

NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9, paragraph 402b, states: "All hoists, except platform hoists shall be tested at least once every 4 years with a dummy load equal to hoist's rated capacity."

It is requested the following existing and any new utility substation (USS) hoists, under Space Flight Operations Contract control, be permanently exempted from periodic load testing, as required by NSS/GO-1740.9, paragraph 402b.

USS	Location
138	CD&SC
802A/B	K6-848, VAB Tower B Floor 11
812A/B	K6-848, VAB Tower B Floor 11
816A/B	K6-848, VAB LB West
817A/B	K6-848, VAB LB East
818A/B	K6-848, VAB LB West
820A/B	K6-900, LCC East
821A/B	K6-900, LCC East
833A/B	K6-1193, VABR
858	K6-494, RPSF
921A/B	Pad A, LO2 Fac
922A/B	Pad A, HFF/Main Gate
925A/B	Pad A, RPI/LH2
926A/B	Pad A, High Pressure Gas
930A/B	Pad A, FSS/RSS
950	Pad A, ECS 1
951	Pad A, ECS 2
952A/B	Pad A, PTCR
953	Pad A, PTCR
1029	Pad B, Remote Air
1030	Pad B, LO2 Fac
1031	Pad B, RPI/LH2
1032	Pad B, RSS Hoist Room
1050A/B	Pad B, ECS
1052A/B	Pad B, PTCR

9. Impact if Not Approved

Impact if not approved would be unnecessary exposure of personnel to test weight handling hazards.

10a. Have any design features or procedural controls been eliminated or compromised which would effect the safe operation of the system/operation?

M. Henn, 6/25/01

No design features or procedural controls have been eliminated or compromised which would effect safe operations.

10b. What additional measures have been taken to ensure a safe operation?

- A proof load test will be performed on new USS hoists and extensively repaired, modified or altered hoists.
- The USS hoists are used exclusively to install and remove circuit breakers.
- Typical hoist rating is 500 pounds and typical circuit breaker weight is 220 pounds.
- The USS are key controlled areas used only by low voltage shop personnel.
- Personnel are not working under a suspended load and the only risk is to circuit breakers, if the hoist should fail.
- The hoists are manually operated, use wire rope and have a ratcheting mechanism that acts as a brake.
- The hoists are protected from the environment by being inside buildings or in a facility dedicated to the substation.
- To load test the USS hoists, test weights must be brought in to an area, typically with limited work space, the load test performed, then the test weights removed. There is risk associated with the load test, primarily to personnel, to handle the test weights. Considering the hoists are used exclusively for circuit breakers, the area they are in is access controlled, the hoists have limited moving mechanisms compared to power driven hoists, there is environmental protection for the hoists and the worst case effect of failure is circuit breaker damage, which should be repairable, the value added to perform the periodic load test is not justified in this case, especially considering the risk to personnel associated with handling the test weights.

10c. What are the risks associated with failure to meet the requirement?

The risks associated with failure to meet the requirement are the potential for circuit breaker damage if the hoist fails.

10d. What is the likelihood of occurrence of a mishap with identified controls in place and what are the consequences should the controls fail or a mishap occur?

Likelihood of failure is improbable. Consequences of failure are the potential for circuit breaker damage.

M. Henn, 6/25/01

SIEMENS
Westinghouse

Siemens Westinghouse Power Corporation
A Siemens Company

EHS BULLETIN

To:	**SWPC Startup**	From:	**EHS Department** **A5 Construction & Commissioning**
RE:	Crane Accident Case Study		

Report Submitted By:

Richard Groves
Site Safety / Security Coordinator
Siemens Westinghouse Power Corporation
OPC Wansley Project, Franklin, GA

ACCIDENT SUMMARY

SWPC is building a Turnkey Combined Cycle plant, (Wansley) on an existing Georgia Power plant property. The South of our site borders parallel to a plant under construction with TIC as the General Contractor. The distance from our HRSG to their HRSG is about 30 feet.

Weather conditions: 65F, 60% humidity, light winds <5mph and clear.

On Monday July 23, 2001 at 7:30AM a TIC 50 Ton Grove crane with all of the boom out and outriggers down, but not extended, swung from the South off the HRSG towards the West. To the West of the crane, a service mechanic (for the rental equipment company) was working on the back of his service truck. While swinging the crane, without a load, the crane tipped over towards the West. The boom landed on the service truck and the rigging ball hit the mechanic on the head killing him within 10 minutes.

The crane operator was not hurt when the crane landed on its side. After the crane fell and landed on the ground, the crane operator jumped off the crane and fell as he landed, hitting his head and received a mild concussion. The crane boom started an engine fire on the truck, broke the valve off an acetylene cylinder on the truck, which fortunately did not ignite and started a fire on a generator on the truck bed, which had to be put out with portable fire extinguishers. Plant paramedics arrived within 5 minutes and attended both the mechanic and crane operator. County Fire Dept and ambulance arrived 12 minutes after the accident and tied to revive the mechanic without success.

The crane operator was removed by ambulance 20 minutes after the accident. The GA State Police and the county coroner examined the accident scene. The mechanics body was removed 3 hours after the accident.

He leaves a widow and 3 children.

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Westinghouse

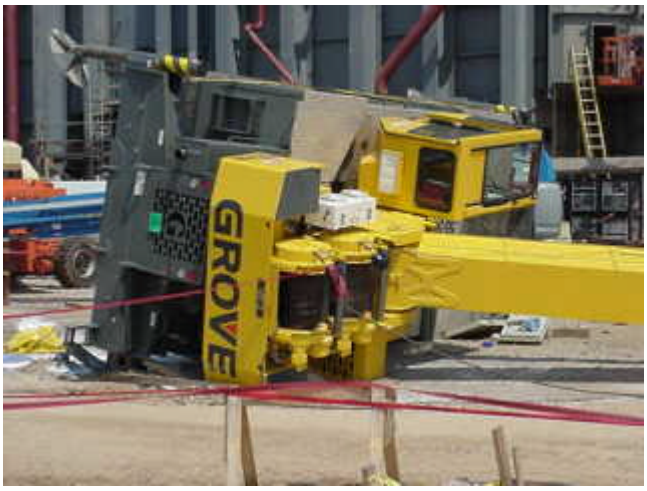
TIC sent their workers home for the next 2 days. OSHA investigated TIC's site for 2 days. The next day, the crane boom was torch cut off the crane, the truck was removed and the crane was uprighted with 3 cranes.

TIC's Toolbox talk 30 minutes prior to the accident was about Crane Safety. The crane operator had over 7 years experience on cranes, but was not a certified crane operator. The crane operator has not returned to the site.

Even without a load on the crane, it still tipped over. Outriggers must be fully extended out when the crane is in use.

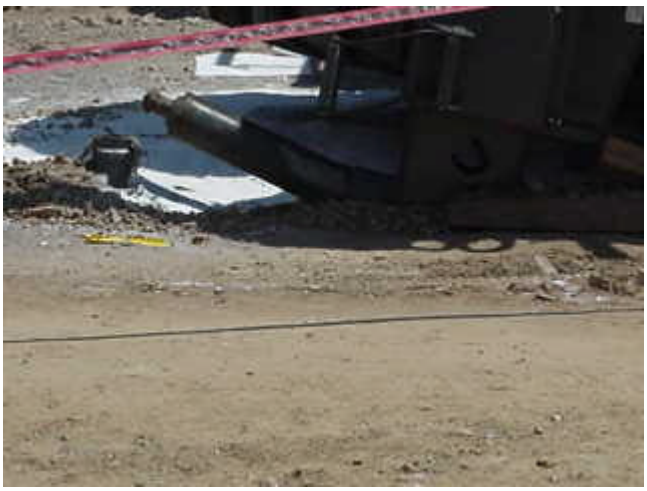
We have no control over a contractor next to our site, but if the crane fell to the North it would have hit 3 carpenters and 2 laborers on our site.

PHOTOS



Looking at back of crane. Red tape attached to a saw horse on our site. Not outriggers down but not extended.

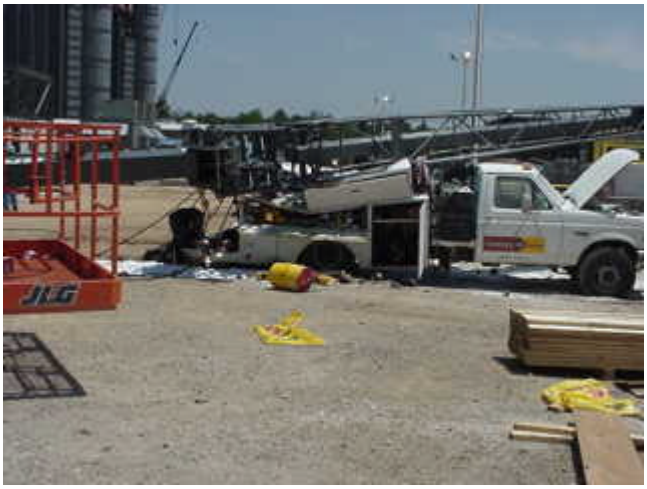
Looking down boom from back of crane. Saw horses delineating our site border.



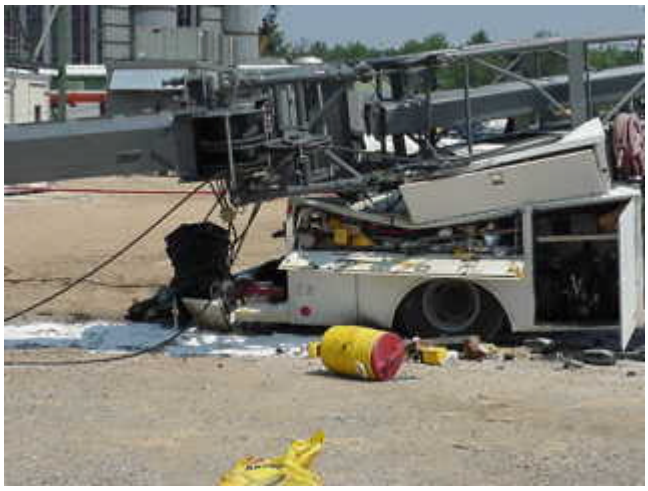
Bent outrigger with base plate still in the ground.

Looking up the crane boom from truck to crane.

Looking at truck from the East.



View of the truck with the crane boom on it. The impact blew the rear suspension on the truck.



Close up of the back of the truck where the mechanic was and the rigging ball.

2. CRANE NEAR-MISS OCCURRENCE AT THE NEVADA TEST SITE

On February 1, 2001, at the Nevada Test Site, a crane inspector accidentally released the block hook of a 240-ton Manitowoc mobile crane after performing a scheduled monthly visual inspection. The crane block hook dropped about 70 feet to the ground, causing the 1,000-pound hook to separate from the auxiliary cable. On the following day, the same crane, having been left in an unsecured position after the inspection, was observed as having rotated to being in close proximity of de-energized power lines. There was no resulting personnel injury or major property damage in this near-miss event. (ORPS Report NVOO--BN-NTS-2001-0001)

On February 1, 2001, a crane inspector and crane mechanic were assigned to perform a monthly visual inspection of a 240-ton Manitowoc mobile crane. A Pre-Task Hazard Review and scope of work were reviewed and agreed to with the work supervisor, crane inspector, and crane mechanic. The monthly inspection is a *visual inspection only* and is considered non-contact work. However, following the visual inspection, the crane inspector started the crane's engine and operated the crane by manipulating the levers and controls. These out-of-scope inspection actions resulted in movement of the 200-foot boom and auxiliary ball and hook. The auxiliary ball and hook inadvertently dropped approximately 70 feet to the ground, causing the 1,000-pound hook to separate from the auxiliary line. The crane inspector then shut down the crane and engaged the dogs and brakes. Both the crane inspector and mechanic left the area without reporting the incident.

On February 2, 2001, an Environmental Restoration employee informed a Safety Officer that the 200-foot boom of the Manitowoc crane was located close (about two feet) to power lines. After verifying and reporting the crane's condition, the Safety Officer prepared a Pre-Task Hazard Review and conducted safety meetings with Utilities linemen and Construction crane operators to place the crane in a safe position and conduct visual checks. The power lines were verified as not energized, and the visual check determined that six of seven dogs and brakes of the crane were disengaged. The boom was raised and rotated back to its proper position and the crane placed in a secured condition.

Fact finding meetings were conducted on February 5 and 6, 2001, to determine the cause of the boom rotation. Interviews with individuals of an Asbestos Abatement crew working near the area of the crane revealed that the crane inspector failed to accurately relate certain events surrounding the crane activities. The inspector had exceeded his authority and failed to comply with the approved work package for non-contact work, resulting in the disengagement of the auxiliary ball and hook and subsequent boom rotation.

Workers must adhere to the defined work control limits and scope of work for the tasks they perform. Ignoring these controls can have serious consequences. In this instance, the approved work package was for a visual inspection that was categorized as non-contact work. However, the inspector conducted unauthorized operational inspections, which could have endangered personnel safety in the work area. The crane inspector also failed to properly secure the crane and report the dropping of the auxiliary ball

and hook. Consequently, the crane moved due to ground slope and weathervaned in the prevailing windy conditions.

This event illustrates the potential hazard to personnel and property when mandatory crane inspections are not performed per the specific work package. General guidance on crane inspection is available in DOE Standard, *Hoisting and Rigging,* (DOE-STD-1090-2001), which can be located at **http://tis.eh.doe.gov/techstds/standard/std1090/1090.html**.

KEYWORDS: *Hoisting and rigging, work planning, crane inspection*

ISM CORE FUNCTIONS: *Define the Scope of Work, Perform Work within Established Controls*

Location of Mishap: M6-342 (Central Instrumentation Facility)

Date / Time of Mishap: April 11, 2001 / 1500

Mishap Summary:

On April 11, 2001, a 15-ton hydraulic crane was being used to lift personnel and supplies for building repairs to the Central Instrumentation Facility (CIF), building M6-342 at Kennedy Space Center. As the crane operator was lowering the man basket for the final time, he heard a thump sound and noticed hydraulic fluid coming from the end of the hydraulic cylinder used to raise the boom. With the hydraulic pressure lost, the boom lowered the man basket to the ground. The employee inside the man basket was not injured. The Material Science Lab at Kennedy Space Center performed a failure analysis of the boom cylinder and packing nut. They determined that the threads failed due to circumferential wear and expansion of the thinner wall housing in the area of the threads. Cost of the replacement boom cylinder was $13,575.

Investigator: Henry H. Brown, Safety Engineer, SGS Safety and Health, phone 853-7086

Mishap Description

On April 11, 2001, a 15 ton Loraine hydraulic crane (SN 88D743) was being used to lift personnel and supplies used for building repairs to the Central Instrumentation Facility (CIF), building M6-342 at Kennedy Space Center. The crane made numerous lifts throughout the day. As the crane operator was lowering the man basket for the final time, he heard a thump sound and noticed hydraulic fluid coming from the end of the hydraulic cylinder used to raise the boom. At the time of the incident, the boom was partially extended to allow personnel to exit the man basket. The man basket was approximately one foot off the ground when the incident occurred. With the loss of hydraulic pressure, the boom lowered the man basket to the ground. The employee inside the man basket was not injured.

Investigation Results

The crane was taken to Hangar U at CCAFS. The boom cylinder assembly was removed from the crane boom. Upon inspection, it was determined that the packing nut was pushed out of the boom hydraulic cylinder. The packing nut is a large piece of metal that screws into the end of the boom cylinder. The packing nut is approximately 12 inches in diameter and about 2 inches thick and is used to contain the hydraulic fluid inside the boom assembly. To raise the boom, hydraulic pressure pushes against a ram inside the boom cylinder. Excess fluid is returned to the reservoir via a vent line. Metal fragments were found in the remaining hydraulic fluid indicating a failure somewhere in the system. Close inspection of the boom cylinder and packing nut confirmed damage to the threads. Crane records indicated the boom cylinder was rebuilt in 1998 at Hangar U. The crane was last load tested on December 15, 2000.

Investigation of the mishap centered on the boom cylinder and packing nut. The entire boom cylinder assembly was sent to the Materials Science Lab at KSC for failure analysis. A copy of their final report is attached. Samples of the packing nut and boom cylinder were sectioned and analyzed for material hardness and indications of stress using a scanning electron microscope and metallurgical techniques. The lab analysis revealed circumferential wear patterns, which would have thinned the threads over time until they could no longer withstand the service load. Additionally, the boom cylinder housing in the area of the threads is thinner than in the rest of the cylinder. Thread deformation suggested that the thinner housing might have experienced expansion under load, which allowed the force on the threads to be transferred from near the pitch diameter toward the thinner thread peaks. This resulted in the sudden gross

longitudinal deformation and catastrophic failure of the threads. The metal fragments found in the hydraulic fluid were from the failed threads.

A telephone call was placed to the crane manufacturer to determine if they were aware of any other similar failures. They did not confirm any failures of this type. However, when the replacement boom cylinder arrived, the thread area was reinforced with a 1 inch wide, ½ inch thick plate around the entire circumference of the boom cylinder.

One other crane of this type was found at CCAFS and two others were found at Patrick AFB. The crane at CCAFS belongs to SGS. The cranes at PAFB belong to the 45th Space Wing Civil Engineering Squadron. The other SGS crane was taken out of service pending a thorough inspection of its boom cylinder. Some wear was noted on the inside of the cylinder ram. As a result, the entire cylinder was replaced. The SGS crane was repaired, load tested and is back in service. A heads up notification of the failure was made via telephone and Email to the Safety Office at Patrick AFB.

Causes and Corrective Actions

Root Cause: Sudden gross longitudinal deformation and catastrophic failure of the threads. This was caused by circumferential wear of the threads and expansion of the thinner housing allowing the force on the threads to be transferred to the thread peaks.

Corrective Action: The replacement boom cylinder has the thread area reinforced to prevent expansion of the housing. No personnel or procedural corrective actions are required as a result of this mishap. A copy of this report shall be forwarded to the 45th Space Wing Safety Office for their disposition regarding their two similar cranes. A copy shall also be forwarded to NASA for dissemination to other NASA centers.

The bulletin attached is about a potential Manitowoc 777 Crane problem. Please share with your Maintenance and Construction groups, including all contractors who might use these cranes.

Subject: POTENTIAL CYLINDER FAILURE ALERT OF MANITOWOC 777 CRANE
This comes from Shell Chemicals at Deer Park near Houston.

POTENTIAL CYLINDER FAILURE ALERT OF MANITOWOC 777 CRANE

PURPOSE
This note describes a type of crane with features that could possibly result in a hydraulic cylinder failure.

SUMMARY OF INCIDENT
The investigation of a near miss which occurred at the Deer Park Chemical Plant, identified the failure of the hydraulic cylinder shaft on a crane that could have catastrophic potential. The crane was a Manitowoc Model 777.

The failure of a boom hoist cylinder on the crane resulted in the boom falling (96 feet in 15 seconds) and coming to rest on a pipe rack. There were no injuries and facility damage was minimal. Information from the report out of the Manitowoc investigation indicated that the cylinder failure was due to the shaft not being heat treated as required. In addition, the piston retainer ring was not machined to specifications. The combination of these two causes apparently resulted in the failure of the shaft.

Manitowoc officials have indicated approximately thirty Model 777 cranes are currently in service that are known to have cylinder shafts that were not properly heat treated during manufacture. Manitowoc has stated they do not intend to take these cranes out-of-service, but will replace the shafts as the new retrofits are made available. At the Deer Park Chemical Plant this model crane will not be allowed in our facility until such time as the retrofit has been made and the appropriate documentation of the retrofit has been presented to us.

RECOMMENDED ACTION
* Identify if this Manitowoc model 777 crane is in use in your facility.
* Do not operate these cranes until deemed safe.
* Call Manitowoc to notify them of the Model 777 crane(s) at your facility and to verify that the hydraulic cylinders have been replaced.