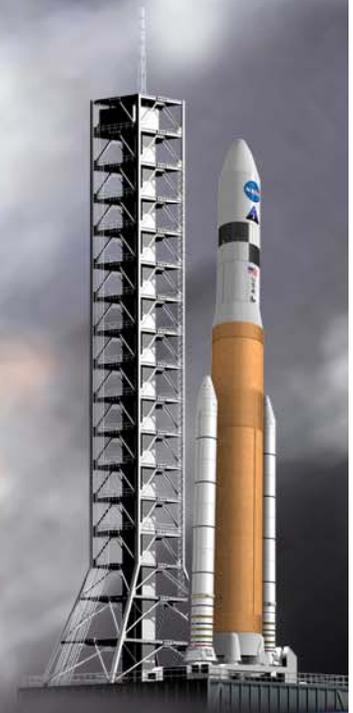


Michoud Assembly Facility (MAF), “Spray in Air” Overview



**Informational
Briefing**



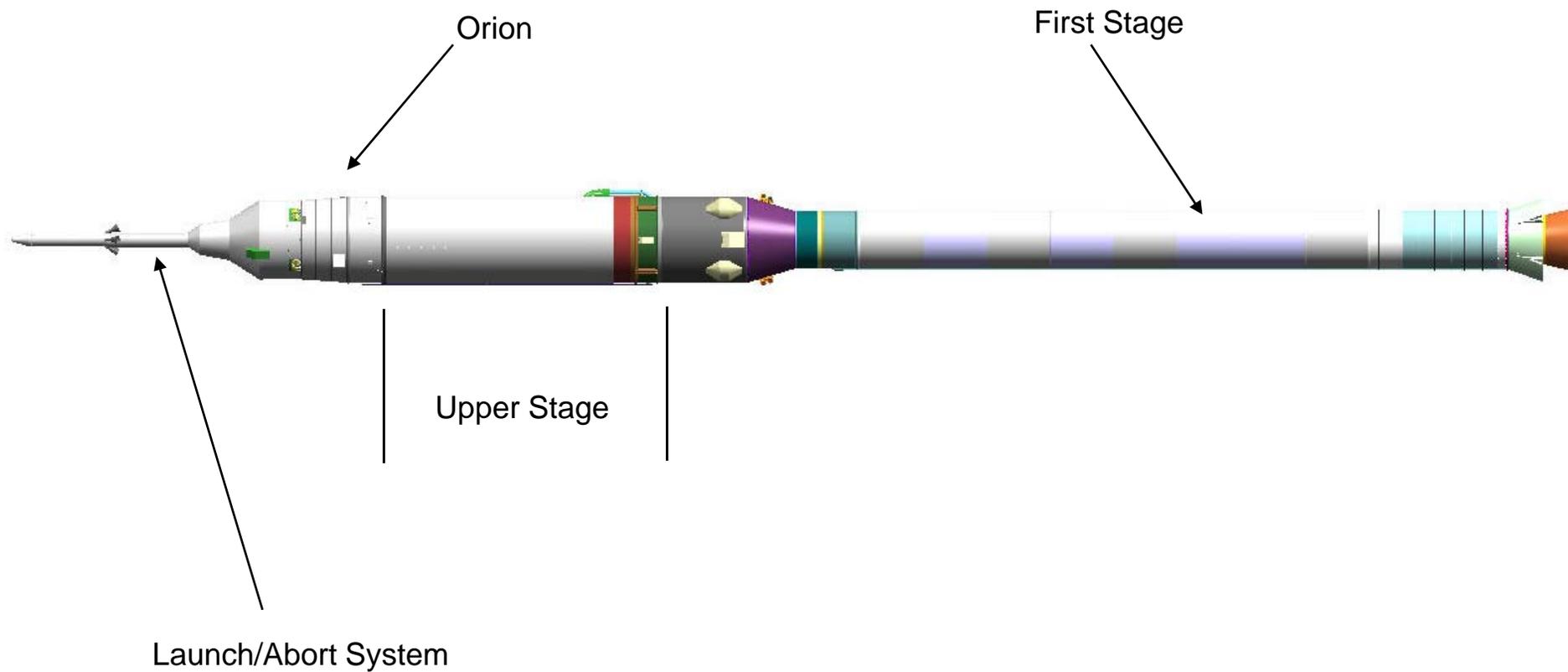
Objectives



- ◆ **Provide Proseco with an overview of the processes envisioned for processing the Common Bulkhead and the Upper Stage**
 - Cleaning processes
 - Surface treatment processes
- ◆ **Review the areas of the Michoud Assembly Facility that could possibly be used for “Spray in Air” processing**
 - Common Bulkhead Cleaning and Surface Treatment
 - Cell E and Cell P Cleaning of the US Exterior
 - Cell E and Cell P Control Rooms
 - Tank Farm supplying Cell E and Cell P
- ◆ **Open Marshall Space Flight Center/Proseco discussions on how the Proseco expertise in spray processing could be applied to US processing needs**
 - Identify opportunities
 - Identify additional information needed by both “Teams”
 - Assign actions where appropriate
- ◆ **Identify a date and location for continued discussions and feedback to NASA from Proseco**



Ares

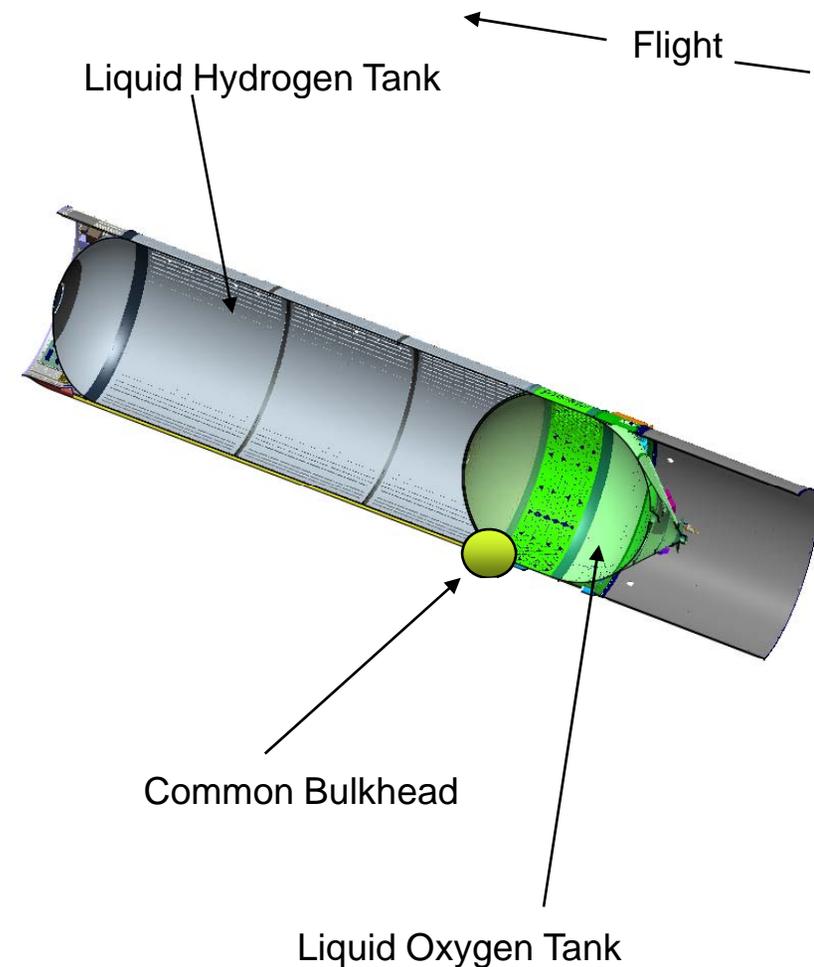




Ares Upper Stage



- ◆ The Constellation Upper Stage (US) can be considered one large tank that is separated into a Liquid Oxygen Tank and a Liquid Hydrogen Tank by the Common Bulkhead (CB).
- ◆ The CB is fabricated separately from the tanks and is a critical component of the US
- ◆ The CB is cleaned separately from the US during fabrication
- ◆ The entire US including the CB is given a final cleaning and corrosion protection treatment at the end of the manufacturing/assembly process



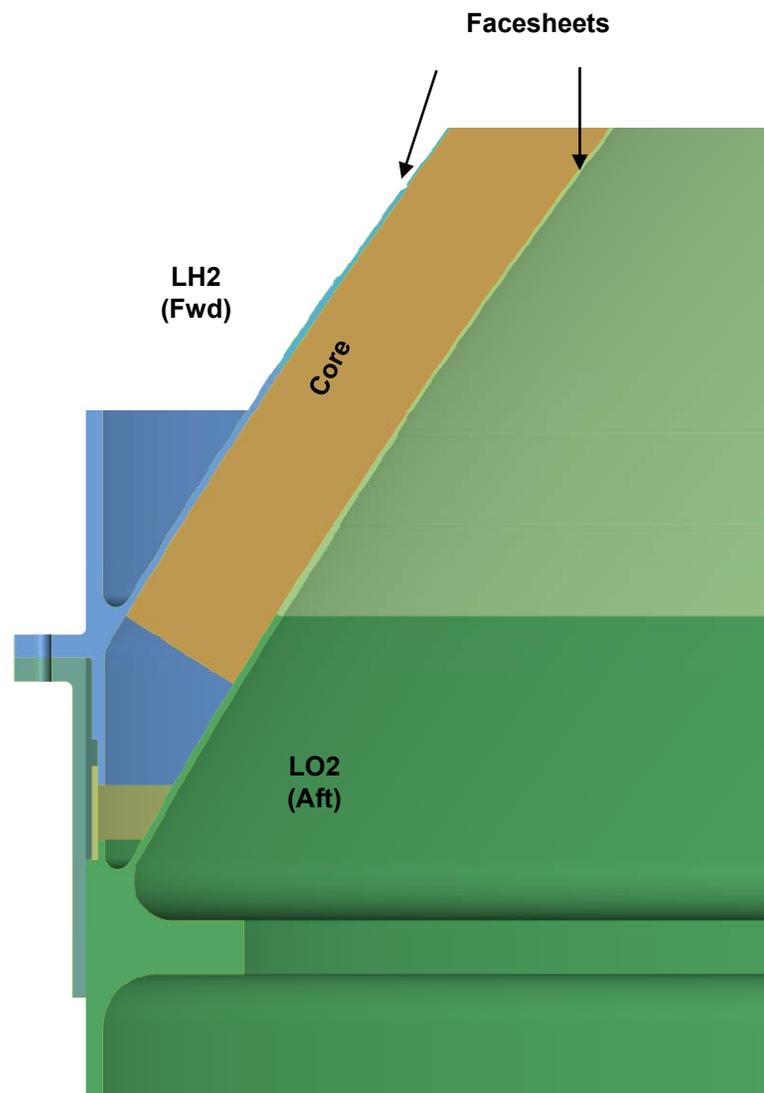
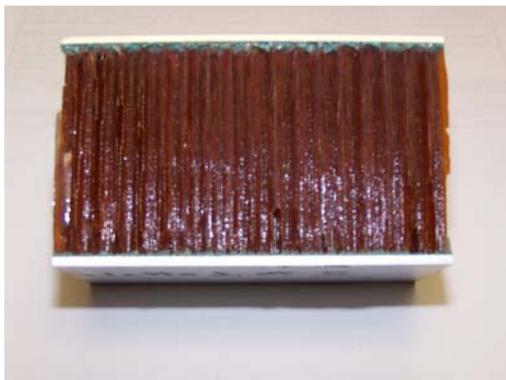


Common Bulkhead (CB)



- ◆ This structure is the **Common Bulkhead (CB)** which is composed of two aluminum Dome/Y-ring assemblies bonded to a common honeycomb core.
 - 2014 T-6 and 2219
- ◆ Each Y-ring/Dome Assembly is 18-feet in diameter and about 6-feet high.
- ◆ The bonding surface of each dome is a critical surface and requires uniform cleaning and surface treatment

Example:
Simulated CB
Core





Common Bulkhead



- ◆ **“Spray in Air” processing is seen as an attractive alternative to the immersion processing (“Vertical Dip”) currently used to clean and apply surface treatment solutions to the Dome/Y-ring Assemblies.**
 - Future upgrade to MAF processing
- ◆ **Vertical Dip Process Steps**
 - Multiple DI Water Rinses between process steps (dip and spray)
 - Alkaline Cleaner
 - Water Break Free Inspection
 - Deoxidation
 - Alkaline Etch
 - Desmut
 - Post Drying, Blacklight Inspection
- ◆ **Final product is a cleaned and etched surface ready to be primed for bonding**
 - Cleanliness inspections to CxP 70145 (Constellation Contamination Control Requirements)

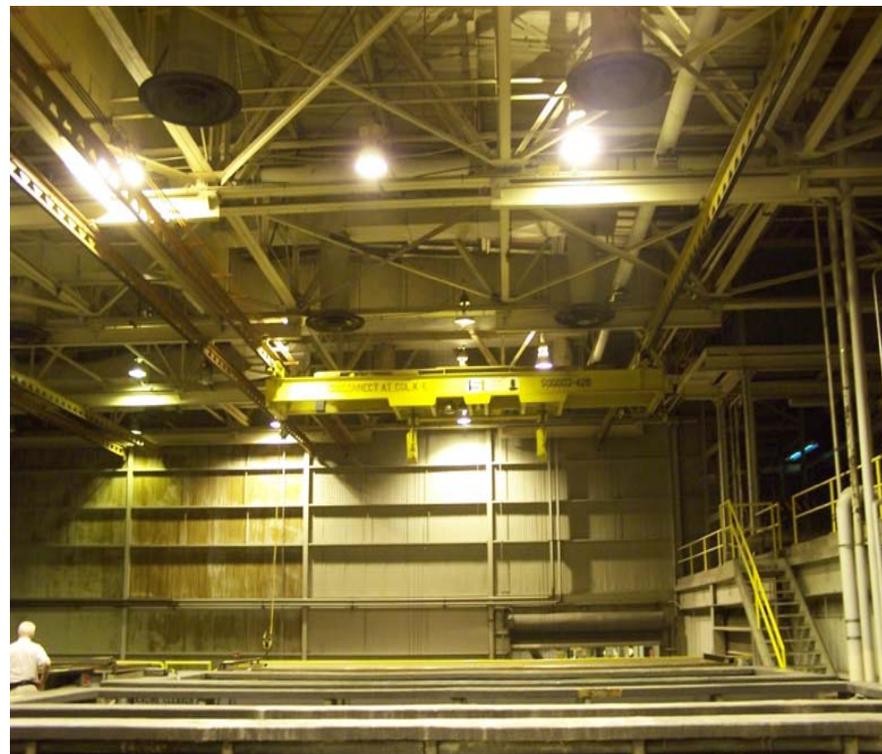


MAF Immersion ("Vertical Dip") Clean Facility



Aluminum Cleaning Line, 10 Tanks

3000-pound Capacity Crane
Estimated 13-foot Hook height

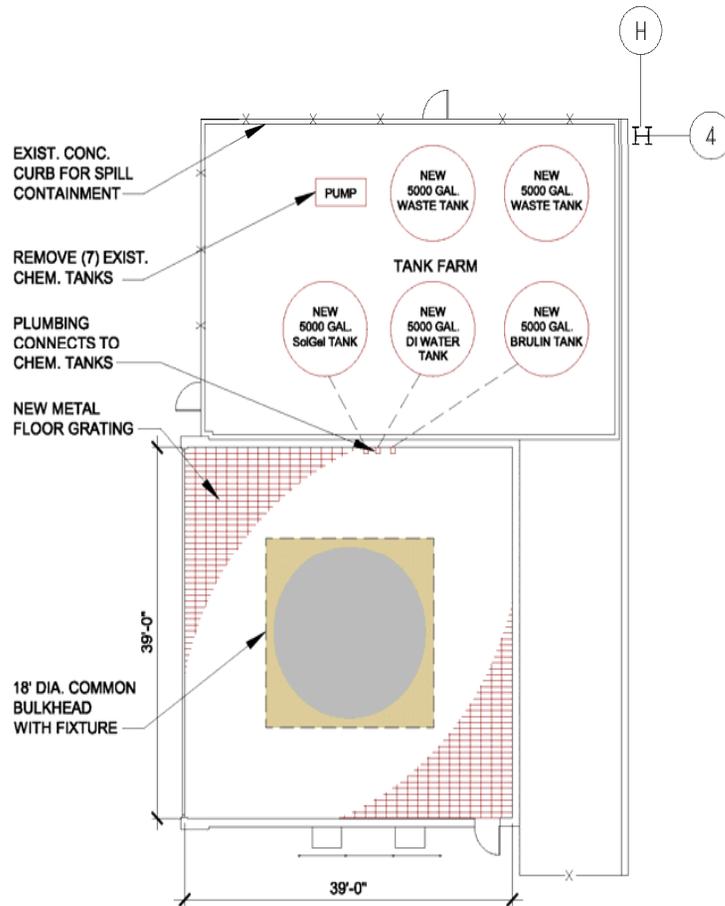




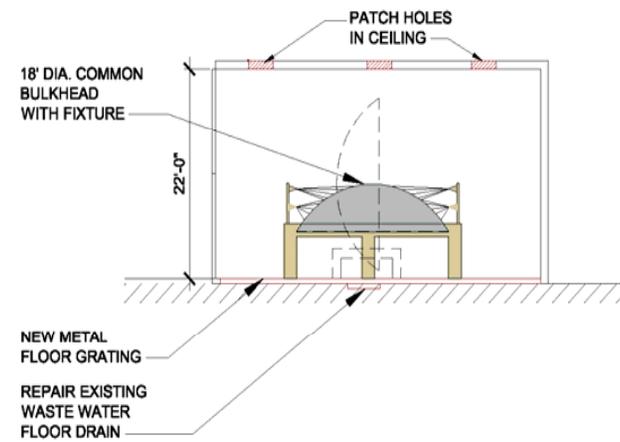
MAF "Dish Washer"



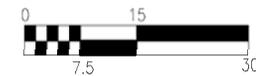
Area 49



PLAN



SECTION



K. Albyn/DeWitt Burns (EM50)



Cell E (Building 113)

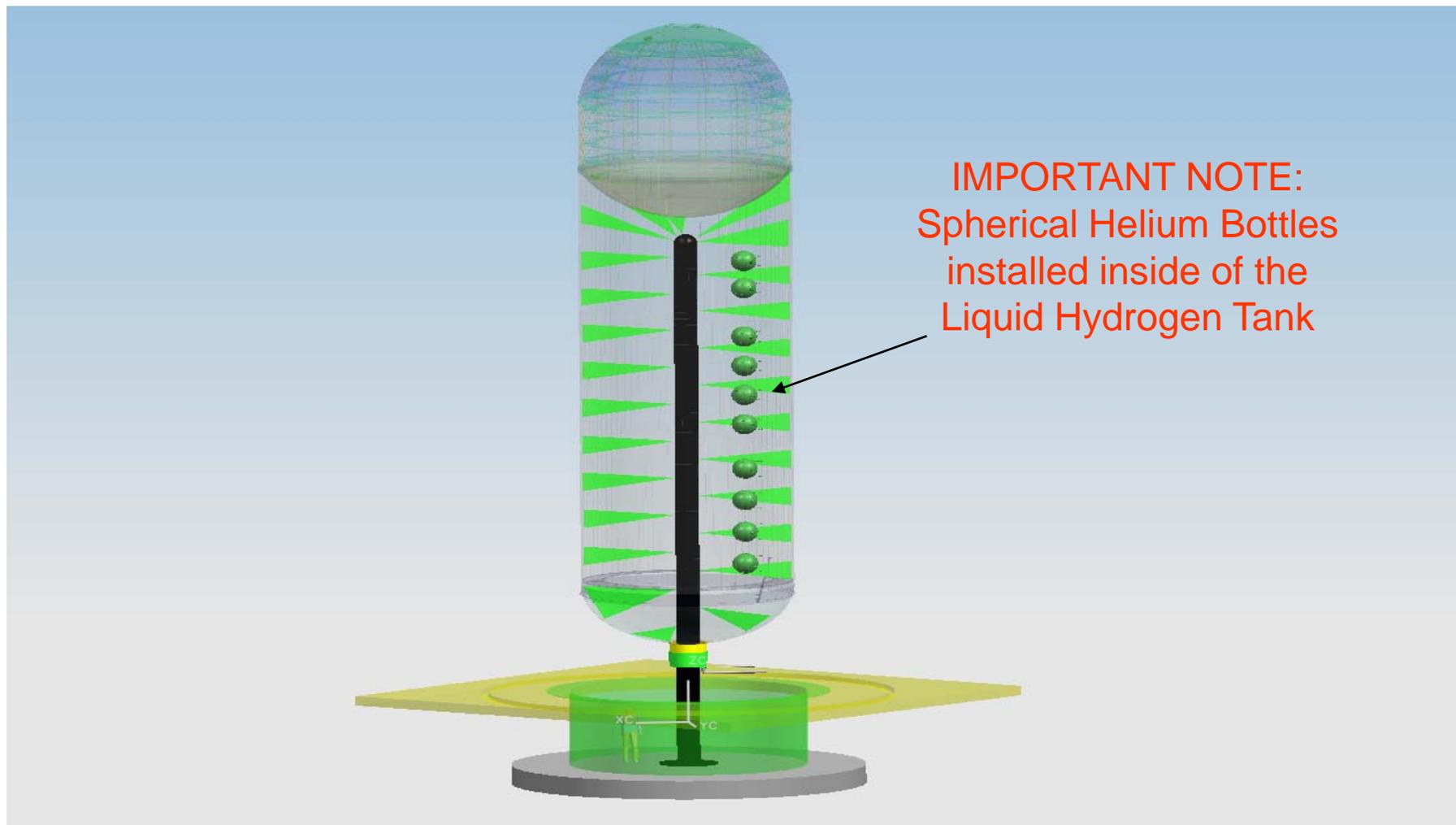


- ◆ **Cell-E is where the assembled Upper Stage will be cleaned by spraying the internal surfaces of each separate tank.**
 - Internal corrosion protection also applied during this process
- ◆ **Each tank will be cleaned separately and the entire Upper Stage will have to be inverted to clean the upper tank.**
 - Single entrance into each tank must be used to insert spray equipment into the tank and also allow cleaning solutions to drain out of the tank DURING the cleaning process
 - Samples must be take from the waste stream to monitor the cleaning of the tank and certify its cleanliness





Liquid Hydrogen Tank Spray Concept





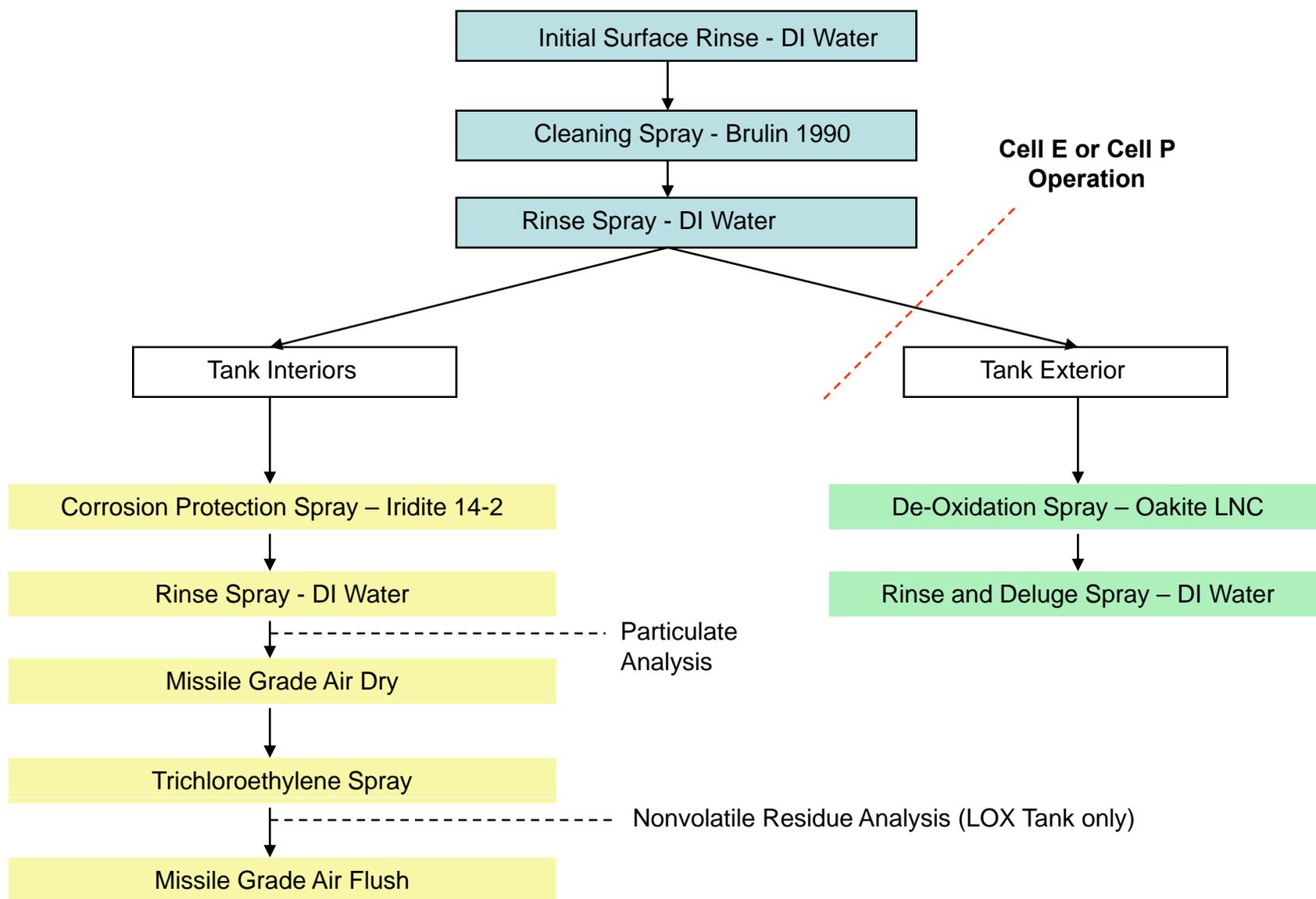
Cell E (Continued)



- ◆ **Cell E is a common use area shared by both the External Fuel Tank (ET) Program and Ares, US**
 - US Cleaning hardware must be removable to allow change out of the facility to support ET
- ◆ **The Cell E Control Room controls the flow and spraying of processing solutions in the Cell from an adjacent Tank Farm**
- ◆ **Major modifications to Cell E and the Tank Farm are not envisioned**



Cell E Process Steps/Chemicals



K. Albyn/DeWitt Burns (EM50)



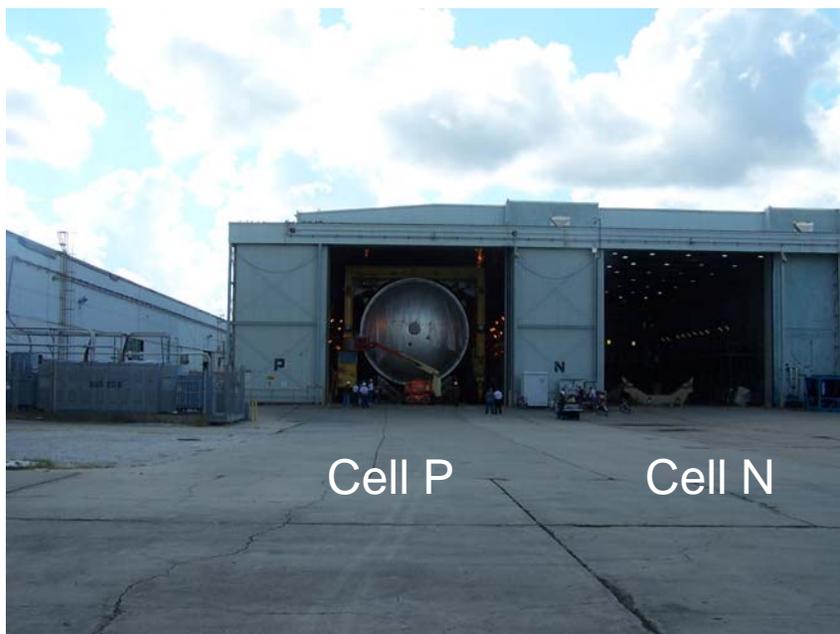
Internal Tank Structures



- ◆ **The interior of the US at the time of cleaning in Cell E will contain structures such as Helium Bottles (Spheres) and slosh baffles.**
 - Positioning and configuration of these structures is fluid and may change as the US design matures.
- ◆ **Some shadowing of surfaces during cleaning is expected and pre-cleaning of some surfaces will be implemented to address these areas.**



MAF Building 131 Cell P



Interior of Cell P, ET being transferred



ET in Cell P





Cell P



- ◆ **Cell P is currently used by ET for several operations**
 - Spray cleaning of the tank exterior
 - Deoxidize of the tank exterior
 - Application of primer to exterior tank surfaces
- ◆ **Cell P could be use to do the same operations on the US exterior**
 - Requires US dedicated, removable fixtures
- ◆ **Cell P is connected to the same Tank Farm as Cell E**
- ◆ **Cell P has its own Control Room**



Back Up Charts





US Notes



◆ Tank Cleaning Requirements (effluent)

- Liquid Oxygen/ Hydrogen Tank
 - Particulate
 - No Particles greater than 1000 microns in any direction
 - Less than/equal to 40 particles between 701 and 1000 microns
 - Less than/equal to 150 particles between 176 and 700 microns
 - There will be no silting
 - Nonvolatile Residue
 - LOX tank no greater than 5-miligrams/square foot (Class B, MSFC-spec-164B)

◆ Nominal Tank Dimensions

- Diameter, 18-feet
- Internal Tank Lengths
 - Liquid Oxygen Tank, 20.2-feet
 - Liquid Hydrogen Tank, 46.0-feet
- US Length, 67-feet (DAC 2)

◆ Maximum Spray Pressure at tank wall and surface of helium bottles in the liquid hydrogen tank is 43 psi



CB Process Steps



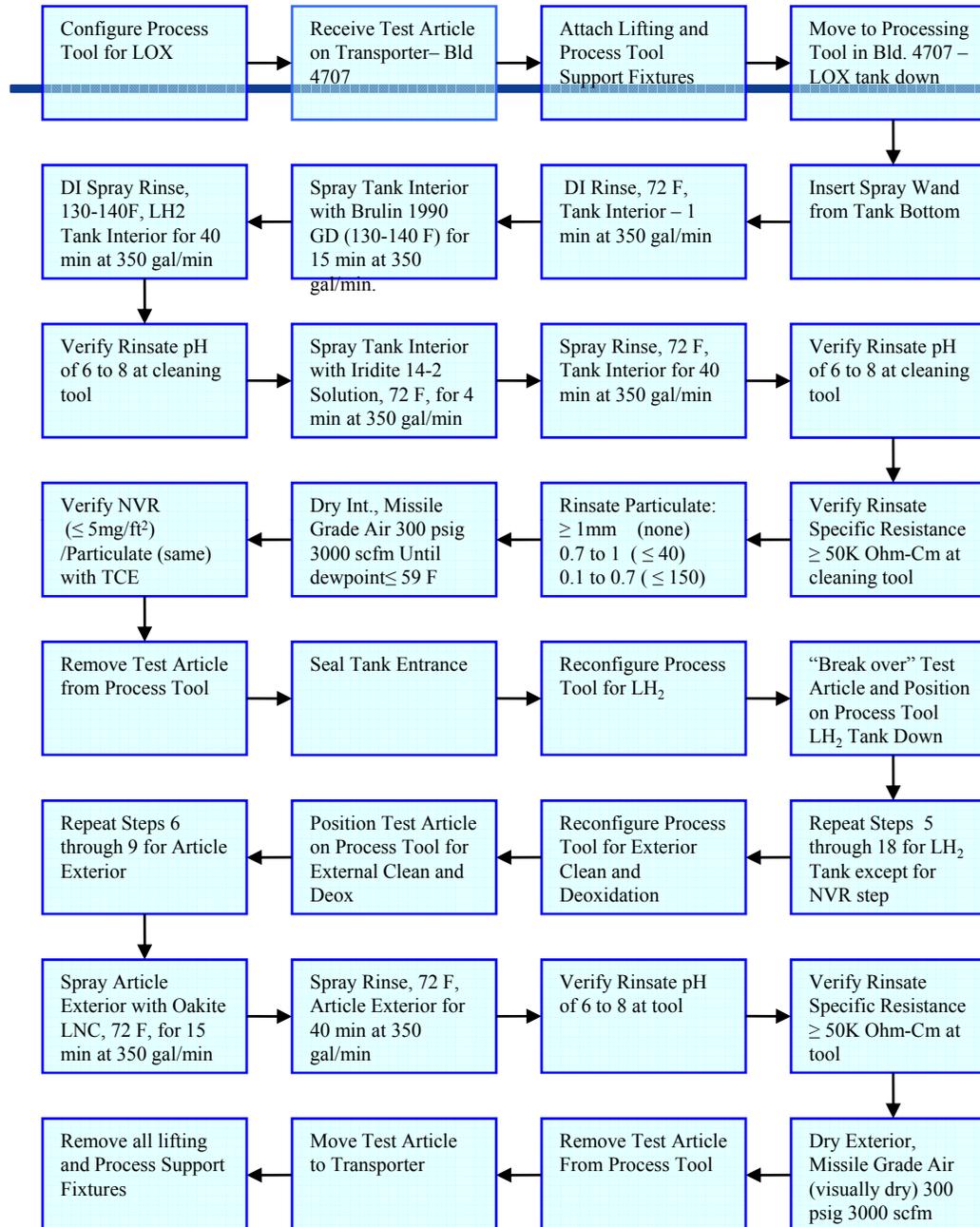
Step	Surface Treatment Process
1	Alkaline Clean: Turco 6849, 5.1-12.8 oz/gal, 140±10°F, 15 minutes min.
2	Spray Rinse: Tap water, ambient, 7 minutes min.
3	Immersion Rinse: Tap water, ambient, 3 minutes min.
4	Spray Rinse: Tap water, ambient, 1 minutes minimum
5	Water “Break Free” Inspection: After momentary spray rinse at upper edge, water shed shall be continuous with no islands.
6	Deoxidation: Henkel Deoxalume 2310 (Desmut 12.8-25.6 oz/gal and Nitric Acid 25.6-38.4 oz/gal), ambient, 7-10 minutes
7	Spray Rinse: Tap water, ambient, 5 minutes min.
8	Immersion Rinse: Tap water, ambient, 3 minutes min.
9	Spray Rinse: Tap water, ambient, 1 minutes minimum
10	Alkaline Etch: Henkel Nova EC202L, 5.1-12.8 oz/gal, 130±10°F, 3-5 minutes
11	Spray Rinse: Tap water, ambient, 5 minutes min.
12	Immersion Rinse: Tap water, ambient, 3 minutes min.



CB Process Steps (continued)



13	Spray Rinse: Tap water, ambient, 1 minutes minimum
14	Desmut: Henkel Deoxalume 2310 (Desmut 12.8-25.6 oz/gal and Nitric Acid 25.6-38.4 oz/gal), ambient, 5-7 minutes
15	Spray Rinse: Tap water, ambient, 5 minutes min.
16	Immersion Rinse: Tap water, ambient, 3 minutes min.
17	Spray Rinse: Tap water, ambient, 1 minutes minimum
18	Spray Rinse: DI water, ambient, 5 minutes min.
19	Forced Air Dry: Empty tank, 120-140°F
20	“Black Light” Inspection: Per CxP 70145, Wavelength=3200 to 3800 Angstroms, Background or ambient light level: Two (2) Foot Candles maximum at the examination (hardware) surface. Black Light Intensity: 1500 microWatts/square centimeter minimum at the examination (hardware) surface.
21	Spray Primer: Cytec BR127, 0.8 to 1.0 mils dry film thickness, with an accuracy of 0.1 mils or better, achieved via 2 or more coats, Relative Humidity (RH) = 40 to 55%, Temperature = 70±5°F, spray system air quality shall meet MSFC-PROC-404 NOTE: Allow 30 minutes between initializing primer coats to allow solvent flash off
22	Dry Primer: 120±10°F for 3 to 8 hours



Proposed processing flow for tank cleaning and "best guess" values

Location not valid for MAF

K. Albyn/DeWitt Burns (EM50)



Constellation Contamination Control Requirements (CxP 70145)



◆ 3.4.1 Visual Cleanliness Level Requirements

a. Generally Clean (GC) Level

Piece parts cleaned to GC level shall be free of manufacturing residue, dirt, oil, grease, processing debris, or other extraneous contamination.

NOTE: Heat-sealed bagging protection is not required, but normal protection is required for handling, shipping, and storage. The GC level should be specified for hardware that is not sensitive to contamination and is easily and quickly cleaned or re-cleaned.

b. Visibly Clean (VC) Level

VC level cleaned hardware shall meet the requirements of the GC Level. In addition, VC cleaned hardware shall be cleaned and qualitatively verified to be free of all particulate and non-particulate material visible to the normal unaided eye. Hardware cleaned to VC levels shall be continuously protected using heat-sealed double bagging. Items which cannot be heat sealed because of size, weight or configuration and which have VC cleaned critical surfaces shall be prepackaged to cover all exposed critical surfaces. Three levels of VC requirements are defined within the VC cleanliness category based on incident light levels and inspection distances.

VC Standard: Incident light level ≥ 500 lumens/m² (50 ft-candles). Inspection distance 1.5 to 3 m (5 to 10 feet [\[L1\]](#)).



CxP 70145 (Continued)



VC Sensitive: Incident light level ≥ 500 lm/m² (50 ft-candles). Inspection distance 0.6 to than 1.2 m (2 to 4 feet).

VC Highly Sensitive: Incident light level ≥ 1000 lumens/m² (100 ft-candles). Inspection distance 0.15 to 0.45 m (6 to 18 inches).

NOTES: 1. For all VC levels, areas of suspected contamination may be inspected at closer distances than specified above.

2. VC level inspections are limited to exposed and accessible surfaces. The use of inspection aids such as wipes, mirrors or tape lifts is permissible for those areas of suspect condition with limited or no direct line of sight.

3. When inspection of piece parts at the minimum inspection distance specified for the required cleanliness level is impractical (for example, having to hold parts cleaned to level VC Standard 5 feet away), closer inspection is permitted [\[L2\]](#) .

4. When interior volumes do not provide sufficient access to physically conduct an inspection within the defined VC range, the inspection shall be conducted at a distance that deviates from the defined range only to the extent required to physically perform the inspection.

[L1] Recommendation from contractors to reinstate minimum distances specified in SN-C-005.

[L2] Attempt to retain the flexibility introduced by original elimination of minimum distance.



Visibly Clean + Ultraviolet (Blacklight) (CxP 70145)



- ◆ **Visibly Clean + Ultraviolet (VC + UV) Level**

For the VC + UV cleanliness level, the hardware shall be free of all visible particulate and non-particulate contamination augmented by inspection under UV light (Ultraviolet light of 3,200 to 3,800 angstroms wavelength). If the surface to be inspected is inaccessible, a wipe test shall be performed and the wiping medium shall be inspected under UV light. All items cleaned to VC + UV level shall be continuously protected using heat-sealed double bagging. Items which cannot be heat sealed because of size, weight or configuration and which have VC cleaned critical surfaces shall be prepackaged to cover all exposed critical surfaces.