FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE
NUMBER: 07-2A-SG1 -X

SUBSYSTEM NAME: EMERGENCY EGRESS WINDOW JETTISON & SKY GENIE
REVISION: 3 09/27/90

PART DATA

	PART NAME / **VENDOR NAME**	**PART NUMBER** / **VENDOR NUMBER**
SRU	: EMERGENCY EGRESS DEVICE	ME623-0012

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

REFERENCE DESIGNATORS:

QUANTITY OF LIKE ITEMS: 7
7 MAX

FUNCTION:
PROVIDES AN ALTERNATE TO SIDE HATCH GROUND EMERGENCY EGRESS, AS A MEANS OF RAPID CREW EGRESS FOR EXIT THROUGH THE FLIGHT DECK EMERGENCY EGRESS PANEL (PORT WINDOW), WHEN ON THE GROUND IN AN EMERGENCY SITUATION. THE DEVICE ASSY CONSISTS OF A CABLE/ROPE ATTACHED TO THE OVERHEAD STRUCTURE ON THE FLIGHT DECK OF CREW MODULE ALLOWING CREWMEMBER CONTROLLED DESCENT DOWN EITHER SIDE OF THE VEHICLE TO GROUND.

FAILURE MODES EFFECTS ANALYSIS FMEA – CIL FAILURE MODE
NUMBER: 07-2A-SG1- 01

REVISION#: 4 09/11/98
SUBSYSTEM NAME: EMERGENCY EGRESS WINDOW JETTISON & SKY GENIE
LRU: **CRITICALITY OF THIS**
ITEM NAME: EMERGENCY EGRESS DEVICE **FAILURE MODE:** 1R2

FAILURE MODE:
SKY GENIE FAILS TO ALLOW CONTROLLED DESCENT RATE

MISSION PHASE: LS LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:
FAILURE OF LINE ATTACHMENTS; INADVERTENT RELEASE AT SHACKLE D AND SNAP SHACKLE (DUE TO SNAG OR FRICTION OF PULL TAB), ROPE OR CABLE BREAK.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN
A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:
A)

B)
"B" SCREEN FAILS BECAUSE THERE IS NO TEST AVAILABLE TO DETECT FOR THIS FAILURE IN FLIGHT.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF CONTROLLED EGRESS CAPABILITY PER CREWMEMBER.

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(B) INTERFACING SUBSYSTEM(S):
SAME AS A.

(C) MISSION:
NO EFFECT.

(D) CREW, VEHICLE, AND ELEMENT(S):
INADVERTENT RELEASE MAY CAUSE CREWMEMBER TO FALL AND RESULT IN LOSS OF LIFE; HOWEVER, OTHER SUBSYSTEM FAILURES MUST OCCUR BEFORE USE OF THE EMERGENCY SYSTEM IS REQUIRED.

(E) FUNCTIONAL CRITICALITY EFFECTS:
AFTER OTHER SUBSYSTEM FAILURES OCCUR REQUIRING THE USE OF THE EMERGENCY SYSTEM, A SINGLE FAILURE OF THE EMERGENCY EGRESS DEVICE CAN RESULT IN POSSIBLE INJURY/LOSS OF CREW.

-DISPOSITION RATIONALE-

(A) DESIGN:
EMERGENCY EGRESS DEVICE ASSY PROVIDES A METHOD OF CONTROLLED LOWERING OF A CREWMAN. THE LINE ASSY, IS CONTINUOUSLY CONNECTED FROM THE FLIGHT DECK CEILING STRUCTURE TO THE CREWMEMBER'S CREW HARNESS ASSY. COMPONENTS INCLUDE 5/32 INCH 302 CRES CABLE WITH HEAT SHRINKABLE TEFLON SLEEVING, 3/8 INCH NYLON ROPE, SLIDING DEVICE SHAFT FABRICATED FROM 356 ALUMINUM CASTING TREATED TO T6, COVER 6061 T6 ALUMINUM, AND TETHER ASSY MADE OF TWO LAYERS OF 1 1/2 INCH NOMEX WEBBING, SHACKLE C INCONEL, SHACKLE D 300SS, SNAP SHACKLE QUICK RELEASE, 17-4 PH. THE SNAP SHACKLE QUICK RELEASE PULL TAB IS SECURED TO THE ADJACENT TETHER WITH VELCRO TO AVOID INADVERTENT SNAG/PULL OF THE RELEASE PIN DURING OPERATION.

BRAKING FRICTION IS PRE-SET (3 1/2 TURNS). DESCENT RATE ALSO CONTROLLED VIA CREW OPERATED ROPE DIRECTION. CONTROLLED FREE FALL OF 29 FEET IS THE MAXIMUM LOAD CONDITION, THIS IS CREATED ON SKY GENIE VEHICLE ATTACHMENT BY TWO CREWMEMBERS EACH WEIGHING 266 LBS. STRUCTURAL ATTACHMENT DESIGN LOAD IS 1715 LBS (2400 LBS ULTIMATE) FOR THE CASE WHEN FIRST CREWMEMBER FREE-FALLS AND JERKS TO STOP, WHILE SECOND CREWMEMBER IS LOADING THE OTHER SKY GENIE. THE MAXIMUM DESIGN LOAD CONDITION ON AN INDIVIDUAL SKY GENIE/LINE SYSTEM IS 1440 LBS (2016 LBS ULTIMATE). STRENGTH OF THE EMERGENCY GROUND EGRESS SYSTEM, FROM THE GENIE TO VEHICLE ATTACHMENT TO THE CREWMEMBER'S HARNESS, HAS AN ULTIMATE MARGIN OF SAFETY OF .19, BASED ON A FACTOR OF SAFETY OF 1.4. CREWMEMBER INITIATED SNAP SHACKLE OPENED BY PULL

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OF PLUNGER PIN VIA TAB IS A QUICK RELEASE OF CREWMEMBER FROM ASSY. SKY GENIE LINE ASSEMBLY IS REPLACED IF USED.

IMPLEMENTED THE ADDITION OF A DOME ASSEMBLY ON THE LEADING EDGE OF THE SKY GENIE IN SUPPORT OF STS-40. ACCEPTANCE TEST VERIFIED ACCEPTABILITY IN A 1-G TRAINER EMERGENCY EGRESS EXERCISE WITH SUITED SUBJECTS.

(B) TEST:
QUALIFICATION TESTS/ANALYSES
STRENGTH OF SKY GENIE TO VEHICLE ATTACHMENT IS 6073 LBS (ANALYSIS). SKY GENIE TO VEHICLE ATTACHMENT IS BONDED TO CEILING PER MA0106-301, WHICH REQUIRES TEST COUPON (TEST COUPONS MUST HAVE 2400 PSI MIN LAP SHEAR, AND APPROXIMATELY 8200 LBS TENSION). SKY GENIE TO VEHICLE ATTACHMENT IS STRESS ANALYZED FOR A MAXIMUM OF TWO CREWMEMBER'S LOADING CONDITION. THE CABLE IS PROOF TESTED TO 1440 LBS; ROPE IS LOT TESTED TO 1250 LBS. ROPE HAS BEEN TESTED TO FAILURE RESULTING IN 4300 LBS MINIMUM STRENGTH. TETHER ASSY HAS A LOAD CAPABILITY OF 3400 LBS BY ANALYSIS BASED ON BREAKING STRENGTH OF WEBBING.

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD. THE OMRSD DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE. IF THERE IS ANY DISCREPANCY BETWEEN THE GROUND TESTING DATA PROVIDED BELOW AND THE OMRSD, THE OMRSD IS THE MORE ACCURATE SOURCE OF THE DATA.

ALL INSTALLATIONS OF EMERGENCY EGRESS DEVICE & ITS ATTACHMENTS AND LINE STOWAGE ARE VERIFIED BY INSPECTION. SKY GENIE IS INSPECTED, PRIOR TO FLIGHT, TO VERIFY PROPER INSTALLATION WITH 3 1/2 TURNS OF NYLON ROPE WRAPPED AROUND THE SLIDING DEVICE SHAFT, WITH COVER TIGHTENED DOWN AND WITH ALL ATTACHMENTS (SHACKLE C, D, AND SNAP) INTACT. INSIDE OF DESCENT DEVICE IS INSPECTED FOR ROPE CONDITION, AND PROPER NUMBER OF TURNS. THE SHACKLE "D" WING NUT OF EACH UNIT IS VERIFIED TO BE SECURE PRIOR TO EACH FLIGHT.

(C) INSPECTION:
RECEIVING INSPECTION
ROCKWELL RECEIVING INSPECTION VERIFIES CERTIFICATION OF MATERIAL, PROCESSES, AND TEST.

CONTAMINATION CONTROL
INSPECTION VERIFIES CLEANLINESS REQUIREMENTS.

ASSEMBLY/INSTALLATION
AT THE SKY GENIE SUPPLIER, EACH COMPONENT OF EGRESS DEVICE IS TESTED AND VERIFIED BY INSPECTION AT THE TIME OF ASSEMBLY. UNIT HAS BEEN CERTIFIED FOR USE BY OSHA AND NASA (REF. CR25-660131-002) AND SOURCE INSPECTED BY ROCKWELL.

CRITICAL PROCESSES

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HEAT TREATING AND SWAGING ARE VERIFIED BY INSPECTION. HEAT TREAT FURNACE CHARTS ARE KEPT IN DATA PACKAGE.

TESTING
2500 LBS PROOF TEST IS PERFORMED ON CASTING, 1440 LBS PROOF TEST IS PERFORMED ON CABLE ASSEMBLY, AND 1250 LBS LOT TEST IS PERFORMED ON NYLON ROPE. RESULTS ARE VERIFIED BY INSPECTION.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE. THE FAILURE HISTORY DATA PROVIDED BELOW IS NO LONGER BEING KEPT UP-TO-DATE.

NO MISSION EQUIPMENT FAILURES. TRAINER FAILURES AT SHACKLE D AND TETHER SNAP SHACKLE CREATED INADVERTENT DISCONNECT.

LEADING EDGE OF SKY GENIE SNAGGED FRSI BLANKET MATERIAL STITCHING, CAUSING SUBJECT TO BECOME HUNG UP DURING AN EGRESS TRAINING EXERCISE. (REFERENCE CAR AD6113-010)

(E) OPERATIONAL USE:
WHEN AN OVERHEAD WINDOW EGRESS IS REQUIRED (BECAUSE THE PRIMARY SIDE HATCH ROUTE IS NOT AVAILABLE), THE EMERGENCY EGRESS DEVICES PROVIDE THE METHOD OF CONTROLLED DESCENT FOR EACH CREWMAN. THE OVERHEAD WINDOW IS NORMALLY 24 FEET ABOVE GROUND LEVEL. FAILURE OF THE DEVICE TO LIMIT DESCENT RATE MAY RESULT IN CREW INJURY AND POSSIBLE LOSS OF LIFE.

CREW ACTION
NONE.

CREW TRAINING
TRAINING IS PROVIDED IN THE PROPER USE OF THE EMERGENCY EGRESS DEVICE. TRAINING INCLUDES SECONDARY DESCENT METHOD USING ROPE WOUND AROUND CREW HARNESS CARABINER AND SNAP SHACKLE RELEASE TO OVERCOME POSSIBLE BINDING ROPE ANOMALY. CREW IS TRAINED TO USE TETHER HANDHOLD DURING DESCENT.

MISSION CONSTRAINTS
NONE. APPLICABLE TO THE POST-LANDING PHASE ONLY.

IN-FLIGHT CHECKOUT
NONE.

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- APPROVALS -

EDITORIALLY APPROVED	: BNA	: J. Kamura 9-16-98
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 96-CIL-032_07-2A