THE RISK MANAGEMENT PROGRAM FOR THE MARS GLOBAL SURVEYOR PROJECT (MGS)

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MGS RISK MANAGEMENT

AGENDA

- MGS Overview Description
- Risk Management Process
- Risk Program
- Risk Assessment Process
- Lessons Learned

Mars Surveyor Operations

MGS OVERVIEW

- Project objective is to recapture as much of the Mars Observer science objectives as possible.
- Spacecraft was launched on Nov 7, 1996 on a Delta II 7925 launch vehicle.
- Spacecraft will be inserted into a 45 hour capture orbit at Mars (Sept 12, 1997), after which it will aerobrake into a low approximately circular orbit from which it can propulsively attain the approximately 2 hr mapping orbit.
- Spacecraft will performing mapping observations for approximately 2 years (one Mars year), and will be available to perform relay activities for landers / penetrators for an additional 3 years.
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MGS OVERVIEW

- Spacecraft was built and integrated at Lockheed-Martin Astronautics in Denver

- Spacecraft extensively utilizes residual Mars Observer avionics and inherited software. Science instruments are a combination of flight spares and built-to-print instruments.

- New elements of the mission, science and spacecraft design included:
  - Aerobraking to attain the mapping orbit
  - New launch vehicle (spinning injection)
  - Composite structure (mass reduction)
  - Propulsion design (response to Mars Observer failure)
  - Telecommunications system design (power constraint)

MGS OVERVIEW

- Spacecraft is being operated by the Mars Surveyor Operations Project, which will also be responsible for operating the follow-on missions of the Mars Surveyor Program (MSP '98 - orbiter and lander, Mars 01 - orbiter, lander and rover, further missions to be defined)

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MGS RISK MANAGEMENT PROCESS

- The MGS Risk Management Plan defines the functions of the risk management program as
  - Identify the potential sources of risk and identify risk drivers.
  - Quantify risks and assess their impacts on cost, schedule and performance
  - Determine the sensitivity of these risks to program, product and process assumptions, and the degree of correlation among the risks.
  - Determine and evaluate alternative approaches to mitigate moderate and high risks.
  - Take actions to avoid, control, assume or transfer each risk, and
  - Ensure that risk is factored into decisions on selection of specification requirements and solution alternatives.

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MGS RISK MANAGEMENT PROCESS

- The risk management process consists of four overlapping (as appropriate) stages: (1) risk planning, (2) risk identification and characterization, (3) risk analysis, and (4) risk mitigation and tracking. The various detailed activities within these four stages are shown schematically in the Risk Management Process Flow Chart (attached).

- A key issue with MGS was to develop a program which provided significant value added without adding a significant cost or workforce burden to the project elements.

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MGS RISK PROGRAM

- MGS risk program incorporated the following elements:
  - Project Risk Retreat
  - Project Risk Workshops
  - Risk Assessment
  - Risk Reporting
  - Risk Mitigation

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MGS RISK RETREAT

- Kicked off the risk program

- Developed a MGS Project Risk Philosophy:

  "We wil deliver the MGS mission for $154M. Project reserves wi l be applied to assure mission critical capabilities, and to mi imize risk with respect to:

  cost containment

  schedule maintenance

  achieving baseline objectives

  ("Reserves" = money, baseline capabilities, time, and technical margins)

- Performed project level risk assessment (initial step in the development of the project risk item list)

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MGS PROJECT RISK WORKSHOPS

- Project Retreat followed by Project Element Manager (PEM) / Cognizant Engineer workshops held at JPL and at our industrial partner (Lockheed Martin Astronautics - Denver)

- Workshop objectives:
  - Transmit Project's understandings of risk definitions, concepts, and nomenclature
  - Present MGS Project risk philosophy
  - Continued risk assessment (continued initial development of project risk item list)

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RISK ASSESSMENT

- **Risk Assessment Process**
  - Utilizes an approach of assessing risk by expected cost impact (see Risk Management By Cost Impact, Eric C. Honour, NCOSE Fourth Annual International Symposium)
    - Project personnel provided inputs into risk database (see input form at the back of this presentation)
    - Project engineer consolidated the material and reviewed it with the system managers and/or project manager, as appropriate, to generate final list, cost impacts and probabilities.
    - Final risk database listing tabulated and published
  - Performed approximately quarterly. Four occurrences during the MGS development (Feb '95 (as part of retreat / workshop program), May '95, Sept '95 and March '96), two occurrences during Mars Surveyor Operations.

RISK ASSESSMENT

- Variety of reports generated
  - Risk database listing (Risk Identification Database)
  - "Expected costs" are compared with available contingencies
  - Contingency ratios are calculated and trends noted
  - Assessment summaries published at formal reviews

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RISK IDENTIFICATION DATABASE

RISK IDENTIFICATION DATABASE, ORDERED BY RISK AREA, IS INCLUDED IN THE BACK OF THIS PRESENTATION

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RISK IDENTIFICATION DATABASE

- The Risk Identification Database maintained an archival record of risks "realized" (risk occurred and some type of correct ve / mitigating act ons was required) and risks "avoided" (ris k did not occur)

- No attempt was made to correlate the estimated cost of the risk with the actual costs ncurred by realized risks.

- The MGS development project risk program (with a defined end date) has now transitioned to the Mars Surveyor Operations Project risk program, which has to address the risks associated with continuing support activities.

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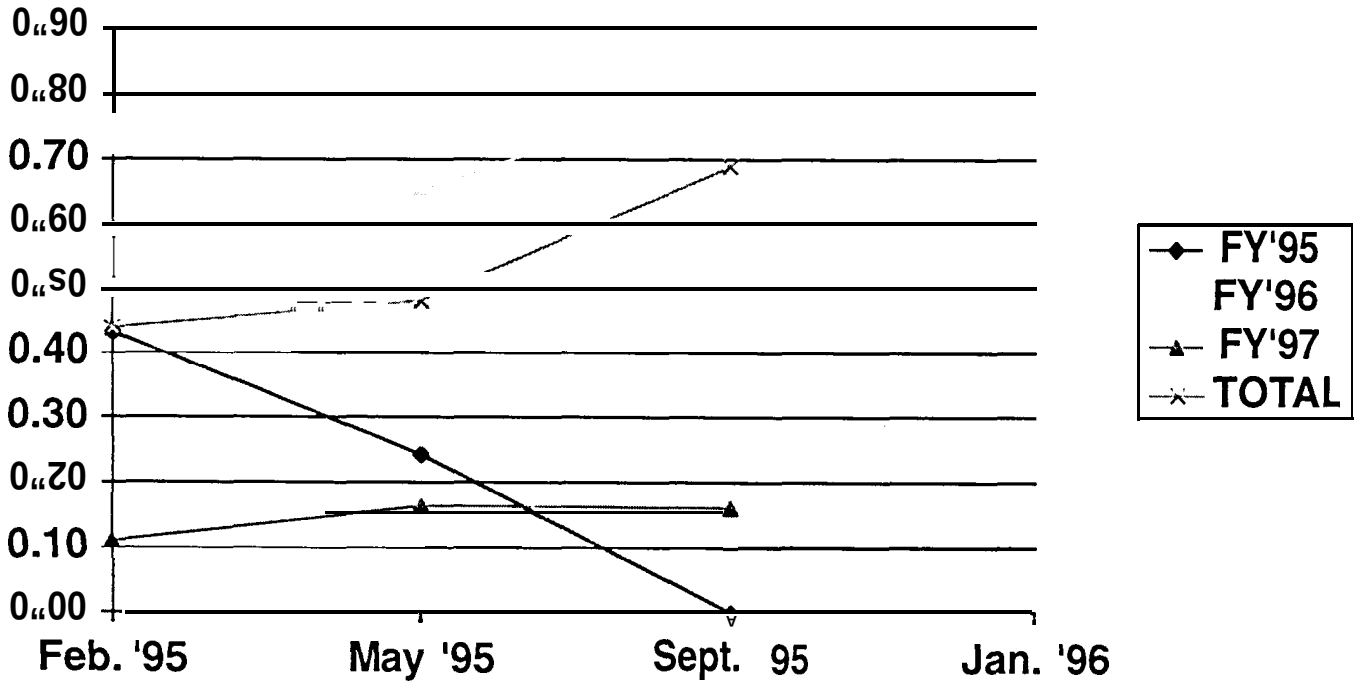
RISK ASSESSMENT / CONTINGENCY RATIOS



Mars Surveyor Operations

MGS RISK ASSESSMENT

Risk Area	FY95 $	FY96 $	FY97 $
PROPULSION SYSTEM DEVELOPMENT • ~~Development problems~~ • Lack of spare hardware • Tank qualification program • GLL checkvalve anomaly	0	120 K	0
AEROBRAKING DESIGN / DEVELOPMENT • ~~Fault protection~~ • Contingency mode recovery • ~~Design effort underscoped~~ • Aerobraking operations design	0	300 K	10 K
INTEGRATION & TEST / DELIVERY SCHEDULES / SPARE HARDWARE • Test and integration problems • Late deliveries • Inadequate ~~assembly, test~~, launch operations support • Lack of spare hardware • Inadequate STL support	0	3335 K	450 K
MASS / MASS PROPERTIES	0	20 K	0

RISK MITIGATION

- MGS Project established a Risk Reduction reserve which was used to fund risk mitigation activities.

LESSONS LEARNED

- An approach such as the one described is useful in giving Project management and sponsors information related to the adequacy of Project reserves.

- The Risk Retreat and Risk Workshops are very useful in communicating the Project's risk approach with the Project team.

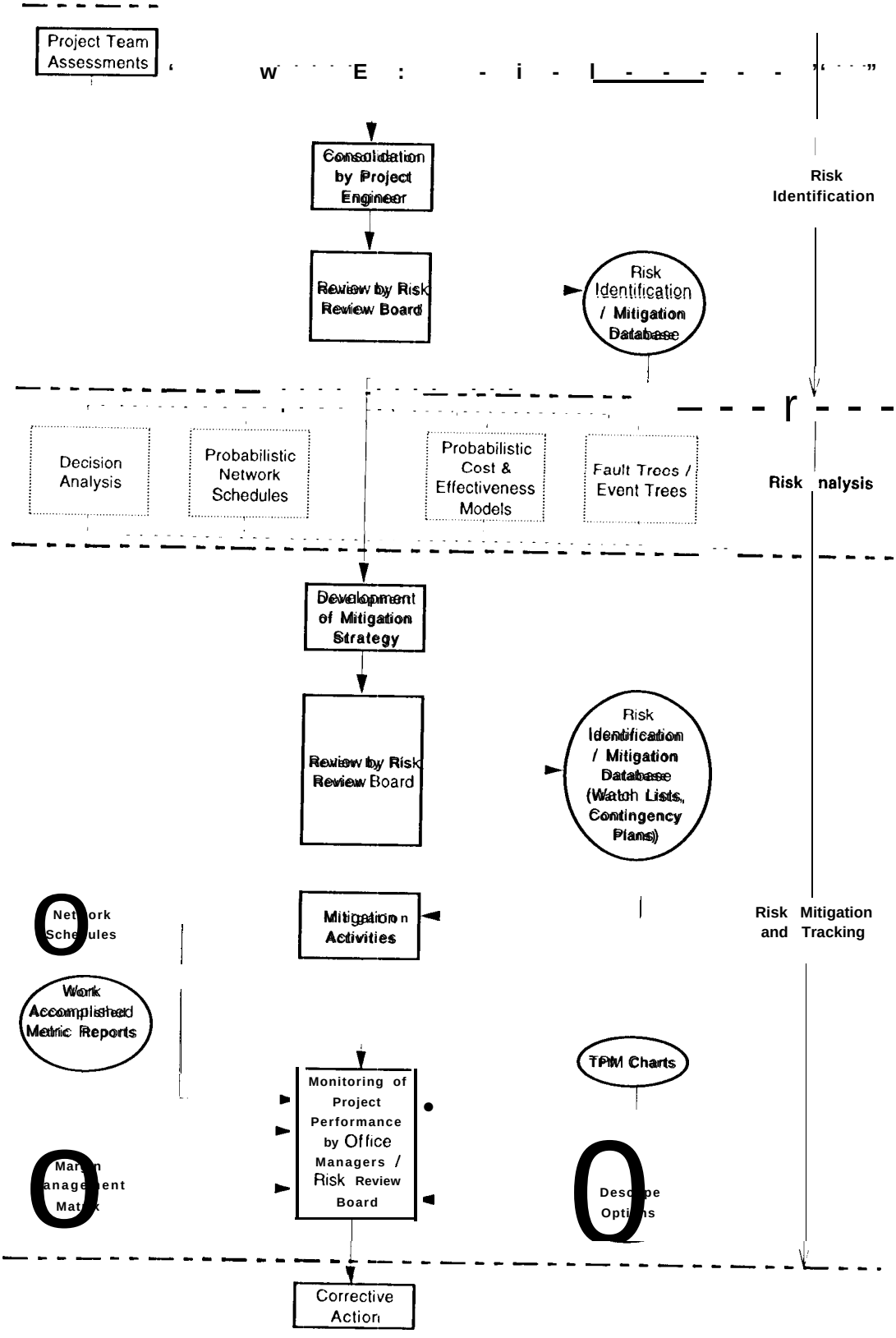
- Risk management by cost impact, normalizing all risks to the dollar impact of corrective action, is an effective methodology.

- Better metrics for correlating risk impact estimates with actual after the fact impacts would be useful.

CONCLUSIONS

- The MGS risk program identified risks, in an organized way, to the project management so that the Project could respond to them.
- The MGS risk program was successful in giving project management high confidence that the project had adequate reserves.
- MGS program provides a measure of risk management with very low impact on project resources. (High value added)

Risk Management Process Flow Chart



MGS RISK APPRAISAL FORM

REF NO. _____
(for project use only)

DATE: _____

NAME: _____

RISK NUMBER	PROB ABILITY	COST IMPACT FY95	FY96	FY97 +	DESCRIBE RISK OR SOURCE OF RISK
1					
2					
3					
4					
5					

PROBABILITY (CHOSE ONE):

10% Low -risk will in all liklihood not occur
30% Medium - risk may occur despite normal care
500/. High - risk may occur even with special management
90% Very High - risk is nearly certain to occur

COST IMPACT:

Estimate the extra cost to the program if the risk occurs; express all schedule and technical risk in terms of cost. Choose a cost impact value only from the following:
$1 OK, $20K, $50K, $1OOK, $200K, $500K, $lM, $2M, $5M

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MGS RISK IDENTIFICATION / MITIGATION DATABASE: DISPOSITIONED ITEMS

BY PROBABLE COST

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RISK AREA	RISK NO.	COST IMPACT $K ('95)	COST IMPACT $K ('96)	COST IMPACT $K ('97)	COST IMPACT $K (MO&DA)	PROB %	DATE	RISK DESCRIPTION	RISK SYSTEM AREA	RISK RECONCILE ACTION	PROB COST $K	PROB COST $K ('95)	PROB COST $K ('96)	PROB COST $K ('97 +)	POTENT COST $K (MO&DA)
A	113		500			10	9/16/94	NO spare LEROS 1 b engine procurement	S/C	OK	50	0	50	0	0
B	128, 76, 119				200	90	2/20/95	Inadequate operations support during aerobraking phase	Mission	OK	180	0	0	0	180
B	119		50	50	100	90	9/16/94	Attitude initialization during aerobraking after any safing entry may be technically impossible due to atmospheric attitude disturbances during celestial attitude initialization	S/C	OK	180	0	45	45	90
B	126		200			50	2/20/95	Inadequate processes, procedures and tools for the incorporation of aerobraking atmospheric data during operations	Mission	OK	100	0	100	0	0
B	127		200			30	2/20/95	Inadequate aerobraking operations design	Mission	OK	60	0	60	0	0
B	125		100			30	2/20/95	Aerobraking atmospheric model immature	Mission	OK	30	0	30	0	0
B	120, 130		100	100		10	9/16/94	Inadequate aerobraking mission profile design	Mission	OK	20	0	10	10	0
C	133			1000		90	2/24/95	Launch site support underscoped	S/C	OK	900	0	0	900	0
C	139		500			90	2/24/95	Deployment testing underscoped	S/C	OK	450	0	450	0	0
C	210		200	100		90	9/14/95	Lack of downstream ATLO planning adversely effects later ATLO activities and causes replanning	S/C	OK	270	0	180	90	0
C	38 157, 158		500	500		50	1/26/95	Spacecraft design or test problems discovered during S/C I & T	S/C	OK	500	0	250	250	0
C	36, 106, 29, 57, 72, 5, 34, 78, 143		300	200		50	1/26/95	Schedule impact on I&T caused by instrument or non-instrument failures or design problems during I&T causing delays -- no spares or rapid repair kits	S/C	OK	250	0	150	100	0

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C	108							support			150	0	150	0	0
C	105, 107, 41, 44, 18		200			50	1/26/95	problems cause late instrument delivery which impacts ATLO schedule			100	0	100	0	0
C	96, 84, 160		200			50	1/19/95	EMI or RF design problems during subsystem or system I&T	S/C	OK	100	0	100	0	0
C	171		500	100		30	5/11/95	STL staffing for testing underscoped	S/C	OK	180	0	150	30	0
C	27		500			30	1/26/95	Capability of system test complex to exercise the spacecraft in all needed modes	S/C	OK	150	0	150	0	0
C	144		200			30	5/8/95	P/L integration problems which cause rework to instrument or S/C	S/C	OK	60	0	60	0	0
C	135		200			30	2/24/95	RWA failure during test program (contamination issues)	S/C	OK	60	0	60	0	0
C	212		100			30	9/14/95	Use of STL equipment in the ATLO environment (because of late deliveries or failures) delays FSW, FP or mission sequence testing	S/C	OK	30	0	30	0	0
C	304		50			30	1/31/96	Modal test uncovers need to modify structural design	S/C	OK	15	0	15	0	0
C	303		1000			10	1/31/96	Spacecraft damaged during poorly planned spin testing	S/C	OK	100	0	100	0	0
C	124		800			10		Lack of spare optics or structure for MOC	Science	OK	80	0	80	0	0
C	310		200	200		10	4/4/96	Hazardous command damages spacecraft	S/C	OK	40	0	20	20	0
C	211		300			10	9/14/95	Lack of signal characterization during box integration effects ability to do trouble-shooting during ATLO or flight operations	S/C	OK	30	0	30	0	0

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C	4, 65		500			50	1/26/95	premature failure of on-board recorder			250	0	250	0	0
E	173		500			10	5/11/95	Late GIDEP alert	S/C	OK	50	0	50	0	0
F	97		300			00	1/19/95	Gimbal failure during [illegible]	S/C	OK	270	0	270	0	0
F	67		1000			0	1/19/95	Battery test program failure	S/C	OK	100	0	100	0	0
F	7 7		500			0	1/26/95	Battery failures caused by new technology in combination with new power management requirements on-board	S/C	OK	50	0	50	0	0
F	140		500			0	2/24/95	Design problem between hybrid solar array and PSE discovered during test	S/C	OK	50	0	50	0	0
F	14		200			10	1/26/95	Dampers, pots etc. prevent deployment during test	S/C	OK	20	0	20	0	0
G	3..		100			0	4/4/96	[illegible] during acoustics (Planner's Guide environment)	S/C	OK	10	0	10	0	0
H	111, 59, 153		200			.0	9/16/94	Fault protection: inadequate documentation, understaffed to support additional req'ts, ERAID development to replace STL testing	S/C	OK	180	0	180	0	0
H	313				500	50	4/4/96	Flight software testing not completed during development	S/C	OK	250	0	0	0	250
H	39, 61, 151		500			50	1/26/95	Flight software development and test problems, including additional requirements, late FSW deliveries and effect on ATLO schedule	S/C	OK	250	0	250	0	0
H	304		00			30	1/31/96	Problems identified in FSW interface to new or modified hardware	S/C	OK	30	0	30	0	0
H	302		500			0	1/31/96	Additional PROM burn required due to problems found during system test	S/C	OK	50	0	50	0	0

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I	165		50			50	5/8/95	Lack of reliability work to adddress instruments problems from MO	Science	OK	2.	0	25	0	0
I	48		500			10	1/26/95	Use of heritage electronics hardware, risk of wear-out, overtest	S/C	OK	5.	0	50	0	0
J	42		200	50		30	1/26/95	Business impacts on spacecraft cost, e.g indirect rate impacts of Lockheed / Martin merger	S/C	OK	75	0	60	15	0
Q	40,37			200	200	50	1/26/95	Flight thermal control problems, e.g. incomplete thermal modeling or model verification in test program	S/C	OK	200	0	0	100	100
Q	141				200	50	2/24/95	Flight software problems post-launch	Mission	OK	100	0	0	0	100
Q	148				100	50	5/8/95	PI's cannot find or rehire competent programmers	Science	OK	50	0	0	0	50
Q	147				100	50	5/8/95	Inadequate computer support at PI's facility for operations	Science	OK	50	0	0	0	50
Q	145				500	≥.	5/8/95	S/C magnetic cleanliness requires additional MAG modeling during mission	Science	OK	150	0	0	0	150
Q	40, 37			200	200	30	1/26/95	Flight thermal control problems, e.g. incomplete thermal modeling or model verification in test program	Mission	OK	120	0	0	60	60
Q	146				200	30	5/8/95	Instrument performance anomaly during cruise	Science	OK	60	0	0	0	60
Q	131				200	10	2/21/95	Dampers, pots, hinges, etc. prevent HGA deployment in flight	Mission	OK	20	0	0	0	20
Q	69				200	10	1/19/95	In-flight battery open circuit	Mission	OK	20	0	0	0	20
Q	70				200	10	1/19/95	Worst case solar flare in inner-cruise	Mission	OK	20	0	0	0	20

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Q	122				200	.0	2/14/95	Dampers, pots, hinges, etc. prevent solar array deployment in flight	Mission	OK	20	0	0	0	20
Q	163				50	10	5/8/95	Inadequate parts stress analysis leads to premature part failure	Mission	OK	5	0	0	0	5
U	82, 16		300			90	1/19/95	Thermal control design problem discovered during subsystem or system tests	S/C	OK	270	0	270	0	0
U	159			100		90	5/8/95	Propellant loading operational complexity	S/C	OK	90	0	0	90	0
U	136				200	50	2/24/95	Mission work arounds required for delta V budget shortfall	Mission	OK	100	0	0	0	100
U	137		200			30	2/24/95	Sponsor requires support not in the current scope of the S/C effort	S/C	OK	60	0	60	0	0
U	109		100			30	9/16/94	Payload / science changes will impose additional effort on contractor and jeopardize cost and schedule performance	S/C	OK	30	0	30	0	0
U	202		1000	500		10	9/14/95	Human error which causes hardware handling damage, test or other failure as a result of schedule pressure and other sources	S/C	OK	150	0	100	50	0
U	71		500			10	1/19/95	Power bus short to chassis	S/C	OK	50	0	50	0	0
U	87, 68		200			10	1/19/95	Failure of PSE at elevated temp not understood, verified, corrected (Mode control instability)	S/C	OK	20	0	20	0	0
U	312		100	100		10	4/4/96	Delta interface incompatability	S/C	OK	20	0	10	10	0
X	52, 49	500	1000	1000		100	1/26/95	**Deleted - Risk Realized** Human error which causes hardware handling damage, test or other failure as a result of schedule pressure and other causes	S/C	**Risk Realized**	2500	500	1000	1000	0

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X	101	500	1000			100	9/23/94	**Deleted - Risk realized** Propulsion development problems	S/C	**Risk realized**	1500	500	1000	0	0
X	91, 63, 74, 13	400	1000			100	1/26/95	**Deleted - Risk Realized** Nutation time constant less than required for PAM-D control stability	S/C	**Risk Realized**	1400	400	1000	0	0
X	30		1000			100	1/26/95	**Deleted - Risk Realized** Insufficient ATLO personnel from all disciplines	S/C	**Risk Realized**	1000	0	1000	0	0
X	55, 104, 105, 107, 41, 44, 18		800			100	1/26/95	**Deleted - Risk Realized** Continued late non-instrument hardware delivery impacts ATLO schedule	S/C	**Risk Realized**	800	0	800	0	0
X	201		800			100	9/14/95	**Deleted - Risk Realized** Late non-instrument hardware delivery impacts ATLO schedule	S/C	**Risk Realized**	800	0	800	0	0
X	207		500			100	9/14/95	**Deleted - Risk Realized** Late PROM burn schedule impacts ATLO schedule and effects environmental testing	S/C	**Risk Realized**	500	0	500	0	0
X	220		500			100	9/22/95	**Deleted - Risk Realized** Launch Vehicle interfaces changes effect spacecraft, requiring additional analysis, testing or design changes	S/C	**Risk Realized**	500	0	500	0	0
X	142		500			100	5/8/95	**Deleted - Risk Realized** MOLA or TES major development problem	Science	**Risk Realized**	500	0	500	0	0
X	22		500			100	1/26/95	**Deleted - Risk Realized** Mission critical SPF's detected because of decision to not redo all FMECA's	S/C	**Risk realized**	500	0	500	0	0
X	221		393			100	9/22/95	**Deleted - Risk Realized** SPAS functionality, documentation and test cases defective	Mission	**Risk Realized**	393	0	393	0	0

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X	118, 110	250				100	9/7 6/94	**Deleted - Risk Realized** Safe Mode PROM size too big for available memory. Will require mitigation techniques or descope in non-volatile functionality	S/C	**Risk Realized**	250	250	0	0	0
X	17, 98, 62, 621		100		100	100	1/26/95	**Deleted - Risk Realized** Aerobraking profile affects spacecraft design (e.g. HGA thermal issues) or flight software design	S/C	**Risk Realized**	200	0	100	0	100
X	161		200			100	5/8/95	**Deleted - Risk Realized** Delays in telecom assembly I&T caused by late component deliveries or design changes	S/C	**Risk Realized**	200	0	200	0	0
X	103, 53, 19		200			100	9/23/94	**Deleted - Risk Realized** Unknown mass growth beyond contingency	S/C	**Risk Realized**	200	0	200	0	0
X	21, 15, 3		200		100		2/24/95	**Deleted - Risk Realized** Harness needs rework due to I/F compatability problems (inadequate end-to-end verification / analysis)	S/C	**Risk Realized**	200	0	200	0	0
X	150		200			100	5/8/95	**Deleted - Risk Realized** Thermal vacuum test underscoped. May require solar input and multiple vacuum breaks	S/C	**Risk Realized**	200	0	200	0	0
X	56, 1	200				100	1/26/95	**Deleted - Risk realized** Late Steerer deliv ery of pressure regulator, parallel path required	S/C	**Risk Realized**	200	200	0	0	0
X	12, 95	200				100	1/26/95	**Deleted - Risk Realized** Flight structure fails static test	S/C	**Risk Realized**	200	200	0	0	0
X	172		200			100	5/11/95	**Deleted - Risk Realized** Flap development problems	S/C	**Risk Realized**	200	0	200	0	0

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X	152		100			100	5/8/95	**Deleted - Risk Realized** Safe Mode PROM testing, additonal A/B safe mode req'ts	S/C	**Risk Realized**	100	0	100	0	0
X	132		50			100	2/24/95	**Deleted - Risk Realized** Late instrument delivery impacts ATLO schedule	S/C	**Risk Realized**	50	0	50	0	0
X	162		100		200	0	5/8/95	**Deleted - Risk Avoided (EIRP req'ts met)** Link margin less than required for 21 kbps S&E-1 or 40KBPS S&E-2 at max range requires changes in mission design and more operational complexity	Mission	**Risk Avoided**	0	0	0	0	0
X	169		500			0	5/11/95	**Deleted - Risk Avoided (Tank completes qual)** Qual tank fails qualification program	S/C	**Risk Avoided**	0	0	0	0	0
X	213		200			0	9/18/95	**Deleted - Risk Avoided (Satisfactory GLL perform)** GLL checkvalve problem requires MGS component redesign	S/C	**Risk Avoided**	0	0	0	0	0
X	175		200			0	5/11/95	**Deleted - Risk Avoided (Test passed)** HGA / TWTA assembly fails acoustic or static testing	S/C	**Risk Avoided**	0	0	0	0	0
X	164		200			0	5/8/95	**Deleted - Risk Avoided (NO test failure)** Lack of end-to-end WCA for PSE and BCA test failure occurs	S/C	**Risk Avoided**	0	0	0	0	0
X	6, 33, 64		1000			0	7/26/95	**Deleted - Risk Avoided (S/A qual successful)** Solar panel cell failures caused by new materials and processes with late environmental testing	S/C	**Risk Avoided**	0	0	0	0	0
X	208		200			0	9/14/95	**Deleted - Risk Avoided (PROM capability retained)** Erosion of PROM burn facilities and capabilities at East Windsor	S/C	**Risk Avoided**	0	0	0	0	0

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X	17		500			0	5/11/95	**Deleted - Risk Avoided (MDAC sep analysis complete)** S/C AACS design not compatible with separation dynamics/despin and requires S/C H/W and/or S/W modification	S/C	**Risk Avoided**	0	0	0	0
X	86		200			0	1/19/95	**Deleted - Risk Avoided (All equip powered on)** Failure of MO heritage components due to lack of turn-on prior to S/C integration	S/C	**Risk Avoided**	0	0	0	0
X	50		200			0	1/26/95	**Deleted - Risk Avoided** Lack of adequate controls on subcontracts and vendors; QA, rel and customer engineering	S/C	**Risk Avoided**	0	0	0	0
X	28		200			0	1/26/95	**Deleted - Risk Avoided (spin balancing at Cape)** Lack of spin balance capability at Cape	S/C	**Risk Avoided**	0	0	0	0
X	174		500			0	5/11/95	**Deleted - Risk Avoided (mealing does not require rebuild)** PSE rebuild required because of mealing problem with circuit boards	S/C	**Risk Avoided**	0	0	0	0
X	131		500			0	2/24/95	**Deleted - Risk Avoided (no relocation)** TES cost growth due to impacts of SBRC relocation, lack of local personnel to supply staffing needs, and lack of infrastructure support	Science	**Risk Avoided**	0	0	0	0
X	168		500			0	5/11/95	**Deleted - Risk Avoided (test passed)** Cable management system fails life test	S/C	**Risk Avoided**	0	0	0	0

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X	117, 58, 21		500			0	9/16/94	**Deleted - Risk Avoided (PROM burn delayed - rework averted)** Safe Mode PROM schedule requires reburn and rework to the hardware with risk to flight hardware integrity	S/C	**Risk avoided**	0	0	0	0	0
X	151	100	300			0	5/8/95	**Deleted - Risk Avoided (qual passed)** Solar Array substrate fails thermal qual testing.	S/C	**Risk Avoided**	0	0	0	0	0
X	77		100			0	1/19/95	**Deleted - Risk Avoided (analysis indicates adequate authority)** Thruster control authority inadequate	S/C	**Risk Avoided**	0	0	0	0	0
X	138	20	20		0	2/24/95	TTACS	**Deleted - Risk Avoided (delivery schedule met)** Late delivery to support I&T	Mission	**Risk Avoided**	0	0	0	0	0
X	123		200			0	2/14/95	**Deleted - Risk Avoided (spare CCD's procured)** Lack of spare CCD's for MOC	Science	**Risk Avoided**	0	0	0	0	0
X	26	10	100			0	1/26/95	**Deleted - Risk Avoided (mods not required)** Modification to TOPEX container to move S/C to Cape	S/C	**Risk Avoided**	0	0	0	0	0
X	35	100				0	1/26/95	**Deleted - Risk Avoided (Schedule met)** Completing I/F, compatability analysis by C&DH CDR	S/C	**Risk Avoided**	0	0	0	0	0
X	54	1000				0	1/26/95	**Deleted - Risk Avoided (EDU testing complete)** Composite structure development	S/C	**Risk Avoided**	0	0	0	0	0

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X	2, 114		500			0	1/26/95	**Deleted - Risk Avoided (Qual tank now in plan)** prop tank vibe testing not done to system test levels, results in loss of tank at system test.	S/C	**Risk Avoided**	0	0	0	0	0
X	89	1000				0	1/19/95	**Deleted - Risk Avoided (Sucessful gapping test)** S/C - PAF launch preload of 3300 lb determined to be inadequate	S/C	**Risk Avoided**	0	0	0	0	0
X	8		1000			0	1/26/95	**Deleted - Risk Avoided (Waiver signed)** Structure failure due to over-testing after rejection of sine vibration test waiver	S/C	**Risk Avoided**	0	0	0	0	0
X	32, 60	200				0	1/2 1/26/95	**Deleted - Risk Avoided (schedule met)** Delivery of STL time to support testing for deliveries of EDF and Safe Mode code	S/C	**Risk Avoided**	0	0	0	0	0
X	301		100			0	1/31/96	**Deleted - Risk Avoided (Existing thermal blankets aedquate)** Planetary protection / micrometeoroid environment drives thermal design	S/C	**Risk Avoided**	0	0	0	0	0
										Prop System	50	0	50	0	0
										Aerobraking	570	0	245	55	270
										I&T + Spare H/W	3465	0	2075	1390	0
										Mass	0	0	0	0	0
										Parts	300	0	5,00	0	0
										New Design	490	0	490	0	0
										Structure	10	0	10	0	0
										Flight S/W + t/p	760	0	510	0	250
										Heritage	75	0	75	0	0
										Business Risks	75	0	60	15	0
										Post - Launch	815	0	0	160	655
										Other	790	0	540	150	100
										TOTAL	7400	0	4355	1770	1275
										Realized Risks	12393	2050	9243	1000	100