ID	Risk	Context
1	This is the first time that the software staff will use OOD; The staff may have a lower-than-expected productivity rate and schedules may slip because of the associated learning curve.	Object oriented development is a very different approach that requires special training. There will be a learning curve until the staff is up to speed. The time and resources must be built in for this or the schedule and budget will overrun.
2	Commercial parts suitability for space applications is unknown; parts failure may lead to system failure and use of space grade parts may cause schedule delays since space qualified parts procurement have a procurement lead time of at least 18 months.	Although commercial parts are more readily available and less expensive, they have not been subjected to conditions in space. Radiation environments can cause the failure of non radiation hardened parts.
3	The high-speed fiber optic data bus is untested technology; the bus will not perform as specified and high data transfer rates will not be sustained.	Fiber optic data bus was selected because of potential for satisfying requirements for maintaining a sustained high data transfer rate. However, the technology has not been used in a space flight environment not has the technology been used to connect the particular CPUs and instruments that will be used on this satellite. Preliminary tests in a simulated environment revealed unexplained anomalies.
4	First time the IR Instrument Project manager is managing a project to go into space; Project may fail due to insufficient / poor management.	The project manager has a degree in electrical engineering and does not know much about software or how to manage it as an integral element of an overall system. He knows that the NASA handbook 7120.5 says that he should have a project plan, preliminary design etc., but he thinks that much of that is unnecessary process baggage from the past way of doing business and is non-added-value. He has bought into the 'BETTER FASTER CHEAPER' slogan and thinks that it can be achieved by cutting processes out, and by cutting out some of the early project documentation and much of the software documentation and processes to reduce cost.
5	Lack of a thorough hardware test program; mission failure due to environmental conditions not tested.	Failure to test hardware parts to the temperature extremes in vacuum could lead to unknown problems surfacing on orbit as the spacecraft experiences thermal variations.
6	Project software schedule and resources were underestimated; Schedule slips, cost overruns, and a reduction in adequate testing time are likely results.	Estimates were made by inexperienced personnel and were based on incomplete information. "Rules of Thumb" that have been validated in similar projects suggest that both schedule and resource estimates are extremely optimistic.

ID	Risk	Context
7	Science requirements have substantial TBDs; late completion of TBDs likely, with reduction in adequate testing time, possible science application software failure, incorrect science data being captured, hardware damage if incorrect safety limits were provided, extensive rework and substantial cost overruns, mission failure if problems not found before system is in operation.	(A) Due to TBDs in the science information about the mission that have not yet been researched enough to obtain conclusions, reasonably certain science requirements are not yet available. Uncertainties in the science requirements exist in the following areas: sensor sampling rates, limit checking constants, sensor data processing algorithms, and which information will be sent to the ground under specific circumstances. (B) Not enough civil service staff or funding for contractors was available in the initial phases of the project to adequately define and document the mission requirements.
8	Mission objectives require the use of new technology in an instrument's detector circuit. The selected approach involves scaling down existing technology to operate at higher frequencies. Manufacturability and survivability of the more delicate part is unproven. Problems in either of these areas may result in schedule delay, cost overruns, or a shortened mission life.	The manufacturing process involves forming a microscopic "whisker" for use in the part. The process is essentially uncontrolled since the vendor cannot directly observe and measure the critical tapered tip of the whisker. Testing can occur on the assembled part only. Furthermore, the delicate whisker is very sensitive to handling damage, especially from electrostatic discharge (ESD). Thus, bad parts may result from poor manufacturing processes or abuse in handling the competed parts during testing and subsequent higher levels of assembly.
9	Lack of an adequate configuration management system; Inability to track parts and materials in case of GIDEP alerts.	The configuration management system selected for use on this project was based on a system previously used by the project manager. However, the pervious use did not have to accommodate the large number of dynamically changing items that must be managed in this project.
10	Yearly congressional NASA budget profiles are subject to change; this may cause the project funding profile to change each year with associated replanning, schedule impacts, labor cost increases, loss of key personnel, or project termination.	This is a typical NASA project; as such, almost every assumption that the project has made about total funding amounts and yearly funding profiles will change over the project lifetime. This includes labor costs, time and cost to replan, shifts in personnel, etc. We usually see cost overruns in terms of schedule slips, increases in labor cost to meet those schedule slips or from trying to use overtime to avoid them, constant replanning and the wasted effort and changes associated with it, and losing key personnel to other projects because we can't maintain consistent funding or have to delay work and wind up with slack time. If the overruns get to be too large in terms of either cost or schedule delays, then we face an early termination of the project by either center management or NASA HQ.

ID	Risk	Context
11	It has recently been decided that the Infrared sensors will be developed in-house and how they will communicate and how sensor data will be processed will be based on assumptions until the detailed design is baselined; the accuracy and completeness of those assumptions will determine the magnitude of change in the IR-SIP Instrument Controller CI and Infrared Sensing Unit CI interface requirements - it could be minor or catastrophic.	This is the first time these sensors will be used on a NASA mission. They will still be under design and definition during the IR-SIP Controller's software specification through implementation phases. Therefore, assumptions about the interface will have to be made in implementing the IR-SIP CSCI and if those assumptions are incorrect, then software rewrites will be necessary. We do have access to a reasonable set of assumptions and information from a contractor who has developed very similar sensors, but again, we don't really feel 100% confident in those assumptions. Problems were not anticipated in the current success-oriented schedule so there is no slack time if the impact of the changes is major. Schedule slips, cost overruns, and reduction in adequate testing time are all possible if the assumptions prove false. System testing does not begin until very late in the development, so if problems are encountered there is usually no time to make changes in the hardware. Therefore, software must provide
12	Resource availability estimates were overly optimistic- schedule shows all resources are available at the start of each WBS element; schedule slips, cost overruns and reduction in adequate testing time are likely.	Estimates were made by inexperienced personnel and were based on incomplete information. "Rules of Thumb" that have been validated in similar projects suggest that both schedule and resource estimates are extremely optimistic. In addition, availability of some of the personnel assigned to this project is contingent upon their completion of tasks on another project to which they are presently assigned.
13	Waterfall lifecycle model is being used to develop all IR-SIP software; it may cause serious integration problems between IR-SIP CI and IR sensor and/or between IR-SIP CI and AA platform leading to a missed launch window, excessive cost to meet window, or failure to successfully integrate the system.	Object oriented development was chosen, in part, because of the requirement to support reuse, concurrency and iterative development. The waterfall lifecycle model is not particularly well suited for object oriented development nor does it lend itself to reuse, concurrency and iterative development.
14	Contracting a different test facility for acoustical testing; parts may be insufficiently tested or parts may be damaged with excessive testing.	If the facility does not have properly trained personnel or the machines are older or not properly calibrated, too much power may be applied or tool little.

ID	Risk	Context
15	The funding and development schedule for the AA satellite is subject to change; IR-SIP schedule slips, cost overruns, and a reduction in adequate testing time are likely as unscheduled changes will have to be made to the software to match AA project changes.	(A) Due to TBDs in the science information about the mission that have not yet been researched enough to obtain conclusions, reasonably certain science requirements are not yet available. Uncertainties in that science requirements exist in the following areas: Sensor sampling rates, Limit checking constants, Sensor data processing algorithms, and which information will be sent to the ground under specific circumstances. (B) Not enough civil service staff or funding for contractors was available in the initial phases of the project to adequately define and document the mission requirements.
16	The C++ compiler selected for use does not come with very good user documentation, as supplied by the vendor; decreased productivity likely as software developers stumble over the same problems.	The staff is unfamiliar with both the OO development approach and the C++ development language. The poor C++ user documentation exacerbates an already difficult situation thereby placing a tremendous burden on the staff. It would be extremely surprising if staff productivity is not adversely affected.
17	This is the first time that software staff has used C++; staff may have lower-than-expected productivity rate, schedules may slip.	The staff is unfamiliar with both the OO development approach and the C++ development language. The poor C++ user documentation exacerbates an already difficult situation thereby placing a tremendous burden on the staff. It would be extremely surprising if staff productivity is not adversely affected. The time and resources must be built in for this or the schedule and budget will be overrun.
18	There is no AA Satellite Simulator currently scheduled for development; probable that the IR-SIP CSCI will fail when initially integrated with the actual AA Satellite since prior interface testing will not have been possible, thus fixes will be done very late in the project schedule and may cause the launch date to slip.	The project manager does not totally understand the necessity of the simulator, that without an AA Satellite Simulator it will be impossible to test the software prior to actual integration with the AA Satellite. Since integration will not be possible until late in the schedule there will be very little time to do corrections, and those we do have to make will be done at a high cost in staff and schedule impacts
19	Ability of new hardware to meet sampling rate timing requirements is unknown; failure to meet sample rate requirements could result in loss of science data and we may need alternative hardware or be forced to accept decreased software performance requirements.	This is the first time this processor and bus have been used by this development staff and all the specifications are not known on them yet. Manufacturer documentation is not uniform in detail concerning the hardware performance.

ID	Risk	Context
20	Subset of IR Post Processing CSCI requirements is to be satisfied with COTS products; Integration time and lifecycle costs may increase from original estimates which assumed significant saving from COTS use, leading to schedule slips and cost overruns.	COTS related savings typically occur in situations in which (A) there is a good match between the functionality required by the application and the functionality provided by the COTS and (B) the scope of functions required is contained in a single COTS or in a set of COTS that have been designed to work together. Otherwise, the cost for modifying and/or integrating COTS can approximate the cost of custom development.
21	Poor communication between the AA Project's system engineering team and the IR-SIP instrument team; substantial errors may occur in the interface between the IR instrument and the AA satellite and spacecraft integration testing may take longer than planned and consume more resources for software changes to correct the problems.	While the Fiber Optics Standard Protocol is being used, command status, and data passing is dependent upon both sender and receiver looking in the same places in the packets for the same information. Definition of message passing between the IR Instrument and the AA Spacecraft, for commands, status, and data, is incomplete and partially erroneous. Changes made by one party or the other, based on engineering necessity, are not (completely or correctly) communicated to the other party and agreement reached.
100	Project resources (personnel number and availability) and schedules were underestimated; schedule slips, cost overruns, reduction in adequacy of development processes (especially testing time adequacy) likely.	Estimates were made by inexperienced personnel and were based on incomplete information. "Rules of Thumb" that have been validated in similar projects suggest that both schedule and resource estimates are extremely optimistic. The time and resources must be built in for this or the schedule and budget will be overrun.
101	Use of C++, the selected compiler, and OOD are new for software staff; decreased productivity due to unexpected learning curves may cause coding schedule to slip.	The staff is unfamiliar with both the OO development approach and the C++ development language. The poor C++ user documentation exacerbates an already tremendous burden on the staff. It would be extremely surprising if the staff's productivity is not adversely affected. The time and resources must be built in for this or the schedule and budget will be overrun.