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PLANETARY PROTECTION, LEGAL AMBIGUITY AND THE DECISION MAKING PROCESS FOR MARS SAMPLE RETURN

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ABSTRACT

As scientists and mission planners develop planetary protection requirements for future Mars sample return missions, they must recognize the socio-political context in which decisions about the mission will be made and pay careful attention to public concerns about potential back contamination of Earth. To the extent that planetary protection questions are unresolved or unaddressed at the time of an actual mission, they offer convenient footholds for public challenges in both legal and decision making realms, over which NASA will have little direct control. In this paper, two particular non-scientific areas of special concern are discussed in detail: 1) legal issues and 2) the decision making process. Understanding these areas is critical for addressing legitimate public concerns as well as for fulfilling procedural requirements regardless whether sample return evokes public controversy. Legal issues with the potential to complicate future missions include: procedural review under NEPA; uncertainty about institutional control and authority; conflicting regulations and overlapping jurisdictions; questions about international treaty obligations and large scale impacts; uncertainties about the nature of the organism; and constitutional and regulatory concerns about quarantine, public health and safety. In light of these important legal issues, it is critical that NASA consider the role and timing of public involvement in the decision making process as a way of anticipating problem areas and preparing for legitimate public questions and challenges to sample return missions.

INTRODUCTION

Since the early days of the space program, requirements for planetary protection have been imposed on space exploration missions to avoid harmful cross contamination during planetary exploration. Specific recommendations for controls have undergone periodic review and revision in light of new information obtained from planetary explorations. /1/ As applied to Mars explorations, deliberations about planetary protection to date have concentrated mainly on forward contamination controls for orbiter and lander missions with the objective of avoiding terrestrial contamination of both the martian environment and on-board scientific experiments. In anticipation of future Mars sample return missions, attention has now shifted to issues of back contamination control, a subject that has not been discussed comprehensively since the Apollo program when extraterrestrial samples were last deliberately returned to Earth.

Context For Mission Planning

Planning for future sample return will most likely occur without definitive answers to some important questions about the origin, existence or fate of life on Mars--if life ever existed there. Consequently planetary protection controls on sample return missions will necessarily have a triple objective: to protect the martian planetary environment by controlling contamination from terrestrial sources; to ensure the integrity of scientific experiments on the mission, especially those exploring for biological and organic constituents on Mars; and to protect Earth and its biosphere from potential extraterrestrial sources of contamination.

Before an official set of planetary protection requirements can be established for sample return missions, extensive reviews of technical and scientific information will be needed. While planetary protection measures from the Apollo and Viking programs will be helpful in formulating specific controls, additional information and research will also be needed. For example, further research into spacecraft materials and decontamination procedures will be necessary for increasing the efficacy and suitability of planetary protection implementation for sample return missions. /2/ In addition, since so much has changed in the public realm since the Apollo years, information about legal and political issues as well as public concerns must be incorporated into deliberations of what constitutes appropriate planetary protection controls for sample return missions. /3,4/

Importance of Non-Scientific Factors

In the current socio-political climate, it is unlikely that scientists and space experts alone will be allowed complete control over all sample return decisions. Especially for the first sample return mission, there is a strong likelihood of public involvement and scrutiny over many aspects of the mission. While it is impossible to predict exactly how scientific, technical, legal, operational and social factors may combine to affect future sample return missions, it is advisable to anticipate how and where problems might occur. Earlier studies have analyzed how public concerns about environment, health and safety, could impact mission success /5/. This paper discusses in more detail two interrelated, non-scientific areas of special concern: 1) legal issues and 2) the decision making process. Understanding these areas is critical for addressing public concerns as well as for fulfilling procedural requirements regardless of whether sample return evokes public controversy. Early resolution of legal uncertainties and fuller understanding of the decision making process will also be helpful for identifying critical R&D needs and for assessing strengths and weaknesses of different mission architectures from planetary protection and risk perspectives.

LEGAL AND INSTITUTIONAL ISSUES-- REQUIREMENTS & AMBIGUITIES

Future Mars sample return missions must follow a number of long-standing constraints that apply specifically to space exploration, including those planetary protection measures imposed by the Outer Space Treaty, NASA management directives and COSPAR guidelines. /6,7,8/ In addition, sample return missions will be subject to requirements and controls imposed by non-space related laws and institutions, many of which were non-existent at the time of Apollo sample returns. Considering the potential for administrative delays, increased costs and missed launch windows if lengthy legal challenges are mounted, mission planners and others should be especially aware of important legal issues from the start . Although it is impossible to predict whether they could become problems for sample return missions, they are nonetheless important to consider because they relate to questions of authority, institutional and jurisdictional control, international treaty obligations and operational matters that could be used to challenge a mission in the courts. To the extent that questions remain unresolved or unconsidered at the time of an actual mission, they offer convenient footholds for challenges in the public realm, over which NASA and its experts will have little direct control. Some of the major issues with apparent legal ambiguity are discussed below.

National Environmental Policy Act (NEPA). Probably the most important legal hurdle for proposed sample returns will be imposed by the National Environmental Policy Act (NEPA), a law that was passed subsequent to the return of lunar samples in the Apollo program. NEPA requires comprehensive, public review of all impacts of proposed federal actions prior to decision making for a project. NASA's internal NEPA guidelines require consideration of possible environmental effects at the earliest stages of study and planning, prior to making decisions to proceed./9/ Because sample return missions could potentially involve significant impacts and intense public debate, it is likely that a formal environmental impact statement (EIS) and public hearings will be required prior to launch, a process that can take as long as several years to complete. Through this process, the full range of impacts, worst case accident scenarios, and project alternatives will be reviewed in the public arena.

Over the years, legal challenges under NEPA have been used by opponents to impose lengthy delays on all types of projects, including space exploration missions and controversial science/technology research with features similar to those anticipated for Mars sample return. As

discussed by Stearns and Tennan /10/, the history of these environmentally related lawsuits, particularly for the Ulysses and Galileo missions and the ice-minus genetic engineering research project, provide clear guidance about the implications of NEPA for sample return missions.

The courts clearly will not tolerate shortcuts in NEPA's procedural and analytical requirements for EIS's, especially if an agency disregards significant environmental impacts or fails to consider specific risks previously identified and articulated by an agency. However, the courts have steadfastly avoided the role of substitute decision maker, especially in controversial situations involving complex technologies or scientific uncertainties. Except in extreme cases with demonstrably inadequate agency decision making, the courts have been reticent to substitute their judgement for the deliberations and findings of technically competent experts relied upon by the agency. Collectively, these judicial rulings indicate without a doubt that fulfilling both the letter and the spirit of NEPA will be an unavoidable requirement for Mars sample return missions. In practice, this means it will be necessary to anticipate all likely criticism and opposition well in advance of launch, make certain that all impacts are adequately considered in the EIS, and provide a complete administrative and research record supporting conclusions and decisions about the proposed sample return mission, alternatives and impacts.

Control, authority, conflicting regulations and overlapping jurisdictions. Under the National Aeronautics and Space Act of 1958, NASA was granted clear and direct authority over a variety of activities related to the successful use of outer space. However, other agencies have control over many Earth-based activities that will be associated with sample return missions (e.g.,land or water transportation, quarantine, environmental quality, occupational safety, emergency preparedness, hazardous materials, human health, aviation, facilities construction,etc.). For example, agencies such as the Environmental Protection Agency, the Department of Agriculture, the Department of Health and Human Services, and the Occupational Health and Safety Administration have responsibilities to review proposed activities with questionable environmental, health, or safety impacts. Still other agencies have oversight responsibilities for more routine activities associated with the mission (e.g., Federal Highway Administration, Federal Aviation Administration, etc.). Depending on the exact mission architecture, the point of reentry, the method of sample pick-up and transfer, and the location of quarantine and handling facilities, multiple agencies and jurisdictions at every layer of government, from the federal level to local zoning and permit offices, could be involved in reviewing or overseeing sample return. Thus, it is possible that decision making about the mission and materials of extraterrestrial origin could be complicated by conflicting regulations, overlapping jurisdictions and uncertain permit and review authority. To deal with these legal and jurisdictional ambiguities, it may be necessary to once again establish an Interagency Committee on Back Contamination (ICBC) similar to that established in 1967 for the Apollo program for joint-agency reviews and deliberations on complicated aspects of sample handling or mission activities.

Uncertainties about quarantine regulations. Whether or not life is detected during in situ sampling on Mars, it will be necessary to quarantine any samples returned to Earth until complete testing is done, presumably under experimental conditions prescribed by NASA. To date there has been no specific domestic legislation passed or even proposed regarding the issues of outbound or back contamination for implementing the Outer Space Treaty. In addition, the extraterrestrial exposure and contamination regulations written for the Apollo program and published in the Federal Register /11/ were rescinded sometime between 1991 and 1992, leaving no legal quarantine requirements or authority under existing federal law for handling extraterrestrial samples. Even the validity of those earlier quarantine regulations was questioned on several legal grounds by Robinson /12/. For example, in contrast to typical "regulatory agencies", NASA has never been granted specific legislative authority either to promulgate or enforce quarantine regulations, despite the fact that it published regulations for the Apollo program. NASA did not publish its lunar quarantine regulations until the day that Apollo 11 was launched, intentionally avoiding required public consultative participation in order to minimize the prospect of administrative delay. In today's socio-political climate, any unilateral decisions about quarantine regulations that attempt to avoid public comment will not likely be tolerated. Furthermore, the act of quarantine involves the detention and/or incarceration of not only samples, but possibly Government employees and other individuals. Quarantine regulations are thus intimately linked with constitutional questions about deprivation of liberty and property over which NASA has questionable authority. Clearly, before a sample return mission can be mounted, significant clarification will be needed on many scientific,

operational and legal questions related to quarantine and exposure concerns in order to minimize the opportunity for challenges and at the same time ensure public security.

Nature of Organism. Even among knowledgeable scientists, there is debate about the nature of life on Mars, should it exist there. These basic questions could translate into technical design considerations with economic implications, operational requirements, and issues of statutory authority over review or handling of returned samples. For example, different laws and agencies would be invoked depending on whether the presumed life in a sample was similar to an infectious agent, an exotic species outside its normal ecological range, a truly novel organism (e.g., genetic engineering), or a hazardous material. It is by no means certain how these basic scientific questions about the nature of martian life will be resolved prior to sample return or how they may contribute to public concerns or legal issues related to the sample return and handling on Earth.

Review of alleged large-scale effects on the environment. Presidential Directive/ NSC-25 requires a review of any "scientific or technological experiments with possible large-scale adverse environmental effects and launch of nuclear systems into space." /13/ As written, it applies to "experiments which by their nature could reasonably be expected to result in domestic or foreign allegations that they may have major and protracted effects on the physical or biological environment... even though the sponsoring agency feels confident that such allegations would in fact prove unfounded." The required review is conducted subsequent to the completion of the EIS, involves multiple federal agencies, and ultimately results in Presidential approval to launch. Historically, the directive has applied to missions with nuclear materials on board. Because Mars missions are likely to have nuclear materials in the form of RTG's, and because the language of the directive is broadly written to include even "unfounded" allegations of impacts, the directive will probably apply to sample return missions.

International implications of sample return. In addition to the domestic legal concerns described above, numerous treaties, conventions and international agreements could apply to sample return activities and potential contamination concerns, especially those related to environmental protection or health (e.g., those related to protection of the living resources of the seas; long range transboundary air pollution; world health, etc.). Domestic laws of other nations could be invoked by individuals or groups who argue that back contamination may cause measurable damages or losses, for example from accidents on land or sea.

DECISION MAKING PROCESS

Legal challenges represent the means by which opponents can stop or delay the mission on either procedural or substantive grounds. It is important to recognize that the legal issues and ambiguities are embedded in a larger decision making process through which questions are raised, analyzed and answered. Like other controversial science/technology projects, decisions about sample return missions will actually be reached through two different, interrelated, and time consuming processes -- one involving scientific/technical decision making, the other involving public decision making. Participants in each process typically have different perspectives and expectations, often seeking answers to very different questions. Understanding the differences in these two processes is important to place questions about sample return in a broader context and to anticipate controversial issues and informational needs.

Scientific & technical decision making vs. public decision making. The scientific and technical decision making process is actually an interrelated series of many separate decisions focused on how to bring samples back to Earth. Decisions, typically made behind the scenes by mission planners and scientists, center mainly on technical details, prescriptive criteria and engineering and economic considerations of space operations and hardware. In contrast, the public decision making process, which plays out through executive and judicial agencies with communication via the mass media, is likely to focus on the safety of sample return and questions about whether samples should be returned to Earth. Discussions by the lay public will probably center on earth-based activities rather than space operations or hardware, emphasizing questions about risks and accident scenarios. Concerns about institutional trust, worst case scenarios, and the sufficiency of measures for handling, quarantine and contamination control are likely to predominate.

Most previous NASA studies of sample return proposals have concentrated on engineering and economic aspects of space operations and hardware, generally beginning with launch and ending with re-entry. Since future legal challenges will most likely emphasize earth-based rather than space operations, mission planners should become more attentive to public concerns about potential post-re-entry accidents and their impacts. Critical scientific and technical concerns related to planetary protection must be addressed in the earliest planning stages, not considered as an add-on to later phases. Priority areas for investigation include sample containment and preservation, breaking the contact chain with the martian surface, fail-safe return to Earth, procedures for recovery and transport of samples after re-entry, development of quarantine facilities and protocols for handling, isolating, and managing samples during scientific study, and reliable methods for dealing with mistakes or technological failures.

CONCLUSION

As outlined by Sagan /14/, there are a number of credible arguments that suggest the need for caution in returning samples from Mars including the yet unexplained reaction of martian soils in Viking microbiology experiments, the possibility of life below the surface in more sheltered conditions, a past martian climate that was wet and warm, the lack of certainty about pathogenicity on Earth, and the likelihood of technological and human errors associated with sample return. These arguments are likely to remain unresolved through the time that decisions are made about future sample return missions, making it impossible to completely assess the dangers to life on Earth from martian samples. In the face of existing domestic laws, opponents can easily raise legitimate concerns about environment, health and safety that might cause unnecessary delays, increased costs and missed launch opportunities. Mission planners would be well advised to anticipate these possible challenges by incorporating planetary protection concerns into mission decisions along with technical and economic considerations. There is no way to eliminate the prospect of legitimate public opposition to sample return missions. However, as noted by Stearns and Tennan /10/, both the number of challenges and the probability that they will be upheld by a court can be decreased by agency recognition that the public has a significant role to play in the development of plans and policies. Thus, serious consideration should be given to legal issues and planetary protection concerns, with particular focus on how they may be invoked in the decision making process.

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