

Overview of the Interagency Nuclear Safety Review Board Playbook

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[Placeholder for Digital Object Identifier (DOI) to be added by ANS]

National Security Presidential Memorandum #20 (NSPM-20) directed the NASA Administrator to establish an Interagency Nuclear Safety Review Board (INSRB), replacing the ad hoc safety review panels used for space nuclear system launch reviews since the 1960s. NSPM-20 provides over-arching direction regarding the Board's purpose and intent. Upon formation of this new entity, its members recognized that more detailed guidance was needed to ensure predictable and reliable performance of the Board's functions. The Board drafted and later approved a guidance document referred to as "the Playbook" for this purpose. This paper will summarize the main features of this publicly-available document, along with providing context for its initial drafting and revision. The goal of this paper is to broaden the degree of awareness by the space nuclear system community of INSRB's activities and intents.

I. INTRODUCTION

Interagency review of the launch of space nuclear systems dates back to the earliest space nuclear system launches of the 1960s. During that time, the Department of Defense (DoD), the Atomic Energy Commission, and later the National Aeronautics and Space Administration (NASA), began coordinating reviews for the launch of TRANSIT satellites using plutonium-238-based radioisotope power systems.

At the same time, the Kennedy and Johnson Administrations issued several presidential memoranda establishing their expectation to be aware of the activities involving these types of launches. By the 1970s these practices evolved into a stable state-of-practice involving ad hoc safety review panels with supporting sub-panels, and the Carter Administration codified this general approach in 1977 via Presidential Directive/National Security Council No. 25 (Ref. 1). This state-of-play evolved in some ways but remained largely stable for over 40 years. This period of time and the factors that ultimately led to the changes invoked by NSPM-20 (Ref. 2) are not a focus of this paper and are discussed elsewhere.³

II. NSPM-20 AND ITS NEXUS TO THE INSRB PLAYBOOK

NSPM-20 creates the INSRB and defines the seven agencies that will provide "technically qualified personnel" to participate on the Board. It further directs that the INSRB will review the nuclear safety analysis for Tier II and Tier III government launches (NSPM-20 defines this tiering) and report its findings to the head of the sponsoring agency in the form of a Safety Evaluation Report. NSPM-20 also defines that: (i) national security may require a restricted review group composition; (ii) the INSRB may "recommend areas for additional analysis where it identifies gaps" but "is not tasked with repeating or conducting its own analysis"; (iii) the INSRB shall engage early "in order to identify gaps in time for mission planners to address them without creating unnecessary delays"; and (iv) the INSRB shall advise the head of the sponsoring agency of any omissions or gaps prior to completion of the Mission Safety Analysis Report (SAR) and may provide recommendations for corrective actions. Importantly, NSPM-20 also extends these tenets to non-government launches (i.e., launches licensed by the Federal Aviation Administration), upon request of the Secretary of Transportation. Finally, NSPM-20 also directs that the "terms of any INSRB review, including the costs of such review, shall be agreed upon between the NASA Administrator and the head of the agency requesting INSRB review."

NSPM-20's direction is the anchor and the framing for the INSRB's activities. It provides the necessary landmarks to ensure INSRB is fulfilling its intended functions without providing the details that guide week-to-week activities in fulfilling those functions. Also, it directed NASA to form the INSRB without clarifying NASA's role relative to the other agencies or providing NASA with any clear authorities in this regard. For these reasons, the Board began by drafting and refining a Charter, which is publicly available and last updated in June 2022, as of this writing.⁴ This Charter defines the standing Board as a consensus body, specifies the role of an INSRB Secretariat appointed by the NASA Chief of Safety and Mission Assurance, and

describes an operating model that supports both sustainment functions (via the Board) and mission-specific review functions (via empaneled INSRB Review Groups (IRGs)). There does exist, at times, the perception that the INSRB is a NASA-Chartered Board with a NASA Chair that oversees the Board's sustainment governance. This is not the case, and it is not a situation directed by NSPM-20. For reasons described later, the INSRB only adopts the model of having a lead agency representative and a singular agency-focused reporting structure for mission-specific reviews.

The Charter also describes high-level guideposts for meetings, general functioning of the INSRB, the development of Mission-Specific Review Plans, and addressing conflicts of interest. The Charter expands the level of specificity on INSRB activities from the one-paragraph level (in NSPM-20) to the seven-page level (the INSRB Charter). However, it still, by its nature as a Charter, leaves many details unaddressed.

For this reason, the Board set out soon after its formation to develop a more detailed guidance document. That document, which became known as the INSRB Playbook (a name chosen simply to distinguish it from the many other guidance documents relevant to aerospace and nuclear activities), was originally issued in December 2021 and later updated in January 2023. The biggest changes in the 2023 update (Revision 2) deal with:

- defining a Review Manager position as the administrative function supporting an IRG review;
- describing in broad terms how the INSRB anticipates that emergent launch authorization basis issues will be approached during the time between INSRB Safety Evaluation Report (SER) issuance and launch;
- defining in broad terms how INSRB anticipates that missions will manage the relationship between their upstream technical peer reviews and their INSRB reviews such that INSRB can leverage the former to the maximum extent possible and thus perform a more efficient review; and
- clarifying a few other specific passages based on stakeholder feedback.

The up-front material in the document describes the hierarchy of INSRB documents and defines key terminology. For instance, it describes the terms used to distinguish between the Board acting in its sustainment function versus individual review groups. It also describes the use of the terms “program office” and “safety analysis team” as distinct elements of the mission with whom INSRB will interact. In addition, it contains a preamble that emphasizes the Board's perspective regarding the use of

the terrestrial nuclear precedent for space nuclear system activities, since this has been a key sticking point in the past, as well as explaining the Board's perspective on creating a scalable and tailorable framework based on the details of the mission's unique aspects, the degree of accepted and applicable standard usage in the safety analysis, and the nature of the upstream technical peer review.

This latter point is important because the Board expects to ultimately review missions ranging from those that are very “high heritage” to those that are very novel, and the review framework needs to accommodate this full spectrum in a way that leads to efficient reviews. The preamble to the Playbook also describes three basic intents of the Board, as follows:

- To provide missions with insightful feedback that promotes good safety practices and culture, while making safety analysis and launch approval activities as effective as possible;
- To provide the community with continuity in safety evaluation that promote stable practices and lessons learned mission-over-mission; and
- To provide Agency Heads (et al.) with insightful reviews that foster confidence when making launch decisions and addressing external stakeholder inquiries.

These intents all conform with the intent of NSPM-20.

The following sections of this paper will highlight the information provided in the five sections of the Playbook, which relate to roles and responsibilities, conduct of business, review scope, review process, and review-related products. The final two sections of this paper describe related resources and the process for receiving and positioning feedback on the INSRB Charter and Playbook.

It is important to remember that the Playbook is non-binding, and sets expectations for how the Board and IRGs will likely behave. It also addresses clarifications in governing policies when identified. Its primary function is to document expectations and boundaries for how INSRB will conduct business, and how INSRB expects that mission owners and product recipients will interface with the Board and IRGs, so as to promote openness and effectiveness in INSRB's activities.

III. PLAYBOOK ROLES AND RESPONSIBILITIES

Section 1 of the Playbook outlines anticipated roles and responsibilities for the varying stakeholders in the INSRB process. Some of these responsibilities carry forward directly from NSPM-20, such as the responsibility of sponsoring agency heads to approve the Terms of Review for each mission evaluated by the INSRB. Others specify responsibilities implied in NSPM-20, but not

explicitly stated, such as responsibilities of the heads of within-agency organizations responsible for supporting INSRB membership to ensure appointees to the Board come from an un-conflicted part of the organization and have a clear understanding of the degree of autonomy and authority intended by the appointment. Still other responsibilities deal with more specific aspects of Board operation, such as the responsibilities of Board members to vote on matters in front of the Board, serve on IRGs when designated, and address concerns elevated to the Board. All of the roles and responsibility definitions align with the processes and activities discussed in the remainder of the document.

IV. INSRB GENERAL CONDUCT OF BUSINESS

Section 2 of the Playbook describes a number of different aspects of week-to-week operation of the Board. For instance, it describes:

- the process for replacing departed Board members or alternates;
- NASA's posture as an equal amongst the agencies, yet that also administers the Board;
- how quorum is established and the general approach to voting and tracking actions;
- the process for empaneling an IRG and how that IRG is to interface with the Board as-a-whole;
- how concerns and dissents will be handled;
- ensuring availability of subject matter expertise; and
- more mundane issues like file management and document revision protocols; etc.

As an example of how the Playbook addresses the aforementioned list of topics, Section 2.4 of the Playbook discusses IRG empanelment. Understand that IRGs are (as their name implies) review groups comprised of a subset of Board members and alternates that review a mission safety analysis and produce the safety evaluation report and other review products. The construct of having designated review groups, rather than having the entire Board participate in every review, was put in to place because it offers the following benefits:

- It allows for the role of a Chair for the review (i.e., an IRG Chair), whereas the Board itself is a Board of equals (i.e., no Board Chair);
- It allows for more effective interactions at the review level, by permitting interactions directly between a smaller group of reviewers and the program office, where appropriate;
- It allows for clearer division of responsibilities when multiple mission reviews occur concurrently; and

- It allows the Board, in its executive function, to focus on strategic, rather than tactical matters.

The primary detriment of having review groups is the additional burden and bureaucracy it can entail. Avoiding unnecessary burden while ensuring consistent focus is the primary balance of interest in executing this conduct of operation model. For this reason, the INSRB empowers IRGs to handle all INSRB-related matters relevant to their review. Should a mission choose to perform a system-specific safety analysis prior to performing a mission-specific analysis, and should it seek review of that system-specific analysis, that system-specific review would be performed by either the Board itself or an IRG, depending on the circumstances and as discussed further later in this paper.

Section 2.4 of the Playbook reiterates the most relevant section of NSPM-20, that being the passages that deal with potential restriction of review membership in cases of national security interests and the discretionary nature of INSRB reviews for FAA-licensed launches. The Playbook describes the conditions where IRG empanelment becomes germane and then describes a multi-step process that addresses the need for information from the program office, the need to establish an IRG that will have an adequate mix of skill sets to perform a competent review, the need to produce documentation of the review plans to ensure that all parties can align on both the program office's intent and the IRG's intent, and the need to have the Terms of Review approved by the sponsoring agency head and the NASA Administrator (or their designees) as required by NSPM-20.

This section also acknowledges that the time may come where the interagency reviews are routine enough that it would make sense for the Board itself to review some Mission SARs directly (as opposed to having that interagency review performed by an IRG), and it suggests criteria for making this evaluation. Meanwhile, Appendix C of the Playbook provides a sample empanelment checklist while Appendix D provides a means for assessing the IRG's skill mix.

V. INSRB REVIEW AND EVALUATION SCOPE

Section 3 of the Playbook focuses on issues related to the scope of the nuclear safety analysis and review, including:

- Differentiation between evaluation and analysis, given NSPM-20's tenet about INSRB not being tasked with repeating or conducting its own analysis;
- The expectation that program offices, and not the INSRB, remain responsible for identifying applicable Federal, state, and local requirements;

- The anticipated review boundaries relative to the many ways the program office may choose to estimate risk, and particularly since NSPM-20 provides safety guidelines without addressing the methods used to develop comparisons to those Guidelines;
- The anticipated review boundaries relative to other uses of nuclear safety analysis, and particularly because nuclear safety analyses used to support the Federal nuclear launch authorization process have sometimes been comingled with information to support broader range safety and radiological contingency planning activities that are outside of the INSRB's evaluation mandate; and
- Aspects specifically excluded from INSRB's anticipated review activities, such as safety management programs, terrestrial activities, postulated accident impacts that do not affect Earth's biosphere, etc.

VI. INSRB REVIEW AND EVALUATION PROCESS

Section 4 of the INSRB Playbook addresses the anticipated process guiderails for INSRB activities during mission conduct, anticipating that each mission interaction will need to be tailorable to the unique circumstances of that mission. The process relies on three broad categorical stages, as described briefly below.

The first broad stage involves the Board (i.e., INSRB in its sustainment function) maintaining general cognizance of safety development activities for missions slated to be subject to INSRB review, and with the Board being available for providing general feedback (essentially in a sounding board role). This is the currently applicable stage for the NASA Dragonfly mission and DoD's Demonstration Rocket for Agile Cislunar Operations mission. This is a stage in which the mission is doing formulation and early work on activities like launch vehicle selection, hardware manufacture, and flight software development. Optionally, a mission that elects to develop and use a system-level nuclear safety analysis (i.e., a Nuclear System SAR) to address the system safety envelope upstream of flight opportunity-specific work can coordinate with the Board to obtain a review of that system-specific nuclear safety analysis either at this stage or during the subsequent stage.

The second broad stage involves active launch authorization basis development and review. Early during this stage an IRG empanels, the Terms of Review are written based on mission-side nuclear safety analysis planning and review-side planning, and agency head approves the Terms of Review. This stage also includes the features described in NSPM-20, including Mission SAR development, identification of gaps prior to completion of

the mission safety analysis and communication of any such gaps to the sponsoring agency head, and issuance of an INSRB SER.

The third broad stage relates to the period of time after SER issuance but before launch. This period of time is nominally 6 to 12 months, but in the case of mission delays, it could be significantly longer. During this period, INSRB anticipates that the IRG will remain empaneled, the mission's change control process will inform the IRG Chair of evaluated changes, and for significant changes that have a potential impact on the quality of the Mission SAR for Launch Approval, the IRG will support discussions of the effect of these changes on the launch authorization basis. The IRG Chair will communicate changes in the INSRB SER via a SER supplement or a memo to the program office, with the sponsoring Agency Head on copy in rare and consequential situations. While the full IRG would be involved whenever circumstances permit, the IRG Chair would have the authority to represent the IRG's interests in fast-breaking situations.

This process has not been fully exercised given the newness of the NSPM-20 process and the INSRB itself. The INSRB fully expects that exercising the process will point to opportunities for improvement, and the Board is committed to continuing to enhance the process, and the Playbook in general. For any particular mission, the details as defined in the mission-specific Terms of Review govern activities for that mission.

Section 4 of the INSRB Playbook also describes other features of the envisioned process. For instance, it provides specific recommendations on how the program office and the IRG/INSRB can establish lines of authority and communication, wherein:

- the program office lead serves as the intermediary between the upstream technical peer review and the IRG;
- the program office lead and the IRG both have formal lines of authority and communication to the sponsoring agency head, the Secretary of Transportation, or their designee, (as applicable);
- the sponsoring agency head or the Secretary of Transportation (as applicable) is the interface with the Office of Science and Technology Policy;
- the INSRB in its sustainment function is not directly involved in mission review matters, having granted that full authority to the IRG; and
- the program office appoints a Safety Analysis Team Technical Representative who can represent the program office's spacecraft, launch vehicle and operations, and nuclear safety analysis interests for routine communications.

This configuration is depicted in Figure 3 of the Playbook.

Section 4 also describes a means by which the upstream technical peer review can be executed and communicated in a way that allows the IRG to fully leverage that activity. In doing so, it first clarifies how INSRB sees this upstream peer review relating to other terrestrial and launch authorization processes for three different example situations: (i) a NASA-sponsored plutonium-based radioisotope power system mission, (ii) a DoD space reactor mission, and (iii) a fully commercial mission. It then offers some best practices related to framing the technical peer reviews and communicating the results of the review, including the basic elements of the documentation that would be provided to INSRB.

The remainder of Section 4 of the Playbook touches upon other specific features of the envisioned process, and also provides top-level entry criteria and success criteria for the major steps in the process.

VII. INSRB REVIEW AND EVALUATION PRODUCTS

The process described in Section 4 of the Playbook, including some elements that derive directly from NSPM-20, relies on specific products to ensure proper documentation and communication of analysis and review perspectives to relevant stakeholders. Section 5 of the Playbook describes these products and provides sample table of contents for many. As with all other features of the Playbook, these product descriptions and proposed contents are not compulsory, but rather provide an articulation of how INSRB perceives that an effective analysis and review can be carried out in order to make the interactions at the time of IRG empanelment and mission Terms of Review authoring more focused.

The key program office products described include:

- The Launch Vehicle Inputs and Accident Environments document (a.k.a., the SAR Databook in past missions);
- The Launch Authorization Basis Strategy (which is somewhat akin to the Safety Design Strategy document for a Department of Energy (DOE) terrestrial activity);
- The Mission SAR for Interim Review; and
- The Mission SAR for Launch Approval.

The key IRG products described include:

- The Mission-Specific Review Plan;
- The Agency Head Gaps or Omissions Report; and
- The INSRB SER.

Meanwhile, the joint products described include:

- The Terms of Review.

In particular, the empanelment process described in the Playbook envisions that the program office's Launch Authorization Basis Strategy and the IRG's Mission-Specific Review Plan will be a joint summary in order to capture key aspects in the Terms of Review approved by agency leadership (with such approval required by NSPM-20).

Section 5 also addresses less significant products like routine information requests.

VIII. APPENDICES AND OTHER RESOURCES

The Playbook also contains several appendices, such as the aforementioned appendix containing a sample IRG empanelment checklist, the aforementioned tables used to complete an IRG subject matter expertise coverage assessment, a discussion of what defines a commercial versus government-sponsored launch, and a sample schedule for program office and INSRB/IRG activities and interactions.

Separately, the INSRB Secretariat maintains an administrative document known as the "INSRB Administration Guide," available upon request. This document contains solely administrative guidance related to administering the INSRB (e.g., document handling information). It mirrors the content structure of the Playbook itself, and only contains additional content in sections where there is a need for additional administrative material documentation. This companion document emerged as a way to shorten the Playbook itself, as some stakeholders noted that the Playbook was becoming voluminous, partly due to information that wasn't of interest to the majority of readers owing to its administrative nature.

IX. DOCUMENT FEEDBACK PROCESS

INSRB does not seek to carry out its activities in a vacuum, and yet it does not have a ready mechanism for routinely engaging with the broader community outside of carrying out its mission review mandate. For this reason, the Board articulated its intents in the Playbook and established a standing feedback form process for receiving and dispositioning external feedback. The feedback form is posted alongside the INSRB Charter and Playbook at NASA's nuclear flight safety website (<https://sma.nasa.gov/sma-disciplines/nuclear-flight-safety>), and stakeholders are encouraged to provide feedback using this mechanism. In addition, the INSRB Secretariat (also listed at this website, and as the corresponding lead author on this conference paper) maintains a distribution list used to notify the community of significant planned or completed revisions to the Charter or the Playbook, and interested stakeholders are encouraged to email the Secretariat for addition to this list.

ACKNOWLEDGMENTS

As is typical of consensus Boards, the authors as individuals do not speak for the Board as a whole. The authors wish to thank our colleagues on the Board for their role in developing the INSRB Playbook and for explicitly approving the content of this conference paper. The authors also wish to thank the many individuals within the broader community who engaged in discussions and document reviews, providing valuable feedback on the INSRB Playbook.

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