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READINESS TEST PLANNING

Infrared Radiation Requirements

Volume I - Summary of Measurements (U)

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Contract No. DASA 01-70-C-0162

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ABSTRACT

(U) This is Volume I in a series of reports on Readiness Test Planning, Infrared Radiation Requirements. The purpose of this series is to produce an experimental plan for IR measurements to be made in the NNRTP series of planned high altitude nuclear tests. These measurements will provide needed information for systems design and will also enhance our knowledge of the phenomenology of IR emission sources and processes.

(U) Volume I is a Summary of Measurements, organized according to test altitude and IR wavelength.

(U) Volume II discusses the background information needed for production of an experimental plan in four chapters entitled: 1) IR Test Measurement Requirements, 2) Nuclear Induced IR Environment, 3) Nuclear Radiation Environment, and 4) Modification of Target Observables.

(U) Volume III deals with 5) Experimental Approach and 6) Experimental Plan.

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IR MEASUREMENTS

I. TEST ALTITUDE ABOVE 250 km

(S) 1. SWIR Radiances (U)

Purpose: These measurements will provide 1) nuclear interference data required for boost track system design, and 2) information about the sources and processes leading to SWIR radiation, e.g. NO, H_2O, CO_2, NO_2, OH, particles and electrons.

Measurement Plan: Spectrometers will be used to measure radiances in the range 2-7 μm with 10 cm^{-1} resolution. Radiometers will acquire data at 2.7, 4.3, 6.3 and 3.8 μm with 0.5 μm bandwidth, 10^{-3} sec temporal resolution, and 0.1 km spatial resolution. Instrument sensitivities must be about 10^{-8} w $cm^{-2}sr^{-1}\mu m^{-1}$. Regions to be examined include the debris patch, β patch and x-ray patch. Vertical and horizontal scans will be made of the detonation region with data acquired at least once every scale height. Measurement times will include 1, 3, 10, 30, 100, 300, 1000, ... secs after burst until radiance has decayed to background level. Rockets will be the principal measurement platform.

(S) 2. Radiances in the 10-12 μm Window (U)

Purpose: These measurements will provide 1) nuclear interference data required for early warning aircraft system design, and 2) information about sources of 10-12 μm radiation; e.g. HNO_3, O_3, metal oxides, CO_2, particles and electrons.

Measurement Plan: A spectrometer will be used to measure radiances in the 10-12 μm atmospheric window with 10 cm^{-1} resolution. Two radiometers will be used to acquire data for the 10-12 μm band: one with 10^{-3} sec temporal resolution, the other with a spatial resolution of 0.1 km. Sensitivities should be about 10^{-11} w $cm^{-2}sr^{-1}\mu m^{-1}$. Regions to be examined include the debris patch, β patch and the x-ray patch. Vertical and horizontal scans will be made at the various regions with data acquired at least once every scale height. Measurement times will include 1, 3, 10, 30, 100, 300, 1000, ... secs until radiance has decayed to background level. Rockets will be the principal measurement platform supported by aircraft.

(S) 3. Radiances in the 8-30 μm Range (U)

Purpose: These measurements will provide 1) nuclear interference data for homing and above the horizon system requirements, and 2) information about processes and sources producing radiation in the 8-30 μm range. Some potentially important radiators are: HNO_3, O_3, metal oxides, CO_2, H_2O, particulate matter, and electrons.

Measurement Plan: Spectrometers will be used to measure radiances in the range 8-30 μm with 10 cm^{-1} resolution. Radiometers will acquire data in this range with 1-2 μm wavelength resolution. The radiometer arrays will separately provide 10^{-3} sec temporal resolution and 0.1 km spatial resolution. Sensitivities should be of the order of 10^{-12} w cm^{-2} sr^{-1} μm^{-1}. Regions to be examined include the debris patch, β patch and the x-ray patch. Vertical and horizontal scans of the regions

will be made, with data acquired at least once every scale height. Measurement times will include 1, 3, 10, 30, 100, 300, 1000... secs until the intensity decays to ambient background levels. Rockets will be the principal measurement platform.

II. TEST ALTITUDES 50 TO 150 km

(S) 1. SWIR Radiances (U)

Purpose: These measurements will provide 1) nuclear interference data for boost track system requirements and 2) information about the phenomenology of SWIR radiation, i.e. sources and processes. Some potential sources are NO, H_2O, CO_2, NO_2, OH, particles and electrons.

Measurement Plan: Spectrometers will be used to measure radiances in the range 2-7 μm with 10 cm^{-1} resolution. Radiometers will acquire data at 2.7, 4.3, 6.3 and 3.8 μm with 0.5 μm bandwidth, 10^{-3} sec temporal resolution, and 0.1 km spatial resolution. Instrument sensitivities should be less than 10^{-8} w $cm^{-2}sr^{-1}\mu m^{-1}$. Regions to be examined include the fireball, β patch, x-ray patch, UV excited region, and the heaved-gas region, as appropriate. Vertical and horizontal scans will be made of the regions with data acquired at least once every scale height. Measurement times will include 1, 3, 10, 30, 100, 300, 1000,... secs after burst until radiances decay to ambient background levels. Rockets will be the principal measurement platform.

(S) 2. Radiances in the 10-12 μm Window (U)

Purpose: These measurements will provide 1) nuclear interference data for early warning aircraft systems requirements, and 2) information about the phenomenology of 10-12 μm radiation, i.e. sources and processes. Some potentially important sources are HNO_3, O_3, metal oxides, CO_2, particles and electrons.

Measurement Plan: A spectrometer will be used to measure radiances in the 10-12 μm window with 10 cm^{-1} resolution. Two radiometers will be used to acquire data for the 10-12 μm band: one with 10^{-3} sec temporal resolution and the other with a spatial resolution of 0.1 km. Sensitivities should be about 10^{-11} w $cm^{-2} sr^{-1} \mu m^{-1}$. Regions to be examined include the fireball, β patch, x-ray patch, UV excited region, and the heaved-gas region, as appropriate. Vertical and horizontal scans will be made of the regions with data acquired at least once every scale height. Measurement times will include 1, 3, 10, 30, 100, 300, 1000... secs after burst until radiances decay to ambient background levels. Rockets will be the principal measurement platform.

(S) 3. Radiances in the 8-30 μm Range (U)

Purpose: These measurements will provide 1) nuclear interference data for homing and above the horizon system requirements, and 2) information about the sources and processes producing 8-30 μm radiation. Some potential sources are HNO_3, O_3, metal oxides, CO_2, H_2O, particles and electrons.

Measurement Plan: Spectrometers will be used to measure radiances in the range 8-30 μm with 10 cm^{-1} resolution. Radiometers will acquire data in this range with 1-2 μm wavelength resolution, 10^{-3} seconds temporal resolution, and 0.1 km spatial resolution. Sensitivities should be of the order 10^{-12} w $cm^{-2}sr^{-1}\mu m^{-1}$. Regions to be examined include the fireball, β patch, x-ray patch, UV excited region, and the heaved-gas region, as appropriate. Vertical and horizontal scans will be made of the regions with data acquired at least once every scale height. Measurement times will include 1, 3, 10, 30, 100, 300, 1000,...secs after burst until radiances decay to ambient background levels. Rockets will be the principal measurement platform.

III. TEST ALTITUDES BELOW 50 km

(S) 1. SWIR Radiances (U)

Purpose: These measurements will provide 1) nuclear interference data for boost track requirements and 2) information about the phenomenology of SWIR radiation, i.e. sources and processes. Some potential sources are NO, H_2O, CO_2, NO_2, OH, particles and electrons. Entrainment of cold air by the fireball occurs in this altitude range.

Measurement Plan: Spectrometers will be used to measure radiances in the range 2-7 μm with 10 cm^{-1} resolution. Radiometers will acquire data at 2.7, 4.3, 6.3 and 3.8 μm with 0.5 μm bandwidth, 10^{-3} sec temporal resolution, and 0.1 km spatial resolution. Sensitivities should be near 10^{-8} w cm^{-2} sr^{-1} μm^{-1}. For this altitude range, the fireball is the principal region to be examined. Vertical

and horizontal scans will be made with rocket-borne instrumentation with data acquired at least once per scale height. Measurements from synchronous satellites will be made if feasible. Measurement times will include 1, 3, 10, 30, 100, 300, 1000... secs after burst until radiances has decayed to ambient background levels.

(S) 2. Radiances in the 10-12 μm Window (U)

Purpose: These measurements will provide 1) nuclear interference data for early warning aircraft systems, and 2) information about the sources and processes producing 10-12 μm radiation. Some potentially important radiators are HNO_3, O_3, metal oxides, CO_2, particles and electrons.

Measurement Plan: A spectrometer will be used to measure radiances in the 10-12 μm window with 10 cm^{-1} resolution. Two radiometers will be used to acquire data for the 10-12 μm band: one with 10^{-3} sec temporal resolution and the other with spatial resolution of 0.1 km. Sensitivities should be less than 10^{-11} w $cm^{-2} sr^{-1} \mu m^{-1}$. The fireball is the principal region to be examined. Vertical and horizontal scans will be made with rocket-borne instrumentation acquiring data at least once per scale height. Measurement times will include 1, 3, 10, 30, 100, 300, 1000...secs until radiances decay to the ambient background level.

(S) 3. Radiances in the 8-30 μm Range (U)

Purpose: These measurements will provide 1) nuclear interference data for homing and above the horizon system requirements, and 2) information about the sources and processes producing 8-30 μm radiation. Some potential sources are HNO_3, O_3, metal oxides, CO_2, H_2O, particles and electrons.

Measurement Plan: Spectrometers will be used to measure radiances in the range 8-30 μm with 10 cm^{-1} resolution. Radiometers will acquire data in this range with 1-2 μm resolution, 10^{-3} sec temporal resolution, and 0.1 km spatial resolution. Sensitivities of 10^{-12} w $cm^{-2}sr^{-1}\mu m^{-1}$ are necessary. The fireball is the principal region to be examined. Vertical and horizontal scans will be made with rocket-borne instrumentation acquiring data at least once per scale height. Measurement times will include 1, 3, 10, 30, 100, 300, 1000...secs until radiances decay to the ambient background level.

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