208800-1-F

Final Report

SUPPORT OF COMMANDER'S INDEPENDENT THERMAL VIEWER (CITV) SOURCE SELECTION

AUGUST 1988

Prepared for:

General Dynamics Land Systems Division

Purchase Order: ADE-901176

Contract: DAAE07-86-C-R125

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FOREWORD

The work reported herein was carried out by the Electro-Optics System Laboratory of the Environmental Research Institute of Michigan (ERIM) under General Dynamics Land Systems Division Purchase Order ADE-901176, Contract DAAE07-86-C-R125. The technical director of this effort was H. William Quackenbush.

The contract efforts were in support of the Commander's Independent Thermal Viewer (CITV) Proposal preparation and evaluation. Specifically, the support effort focused on assisting preparation of development specifications and proposal evaluation criteria. This final report is a compendium of white papers and memorandums of meetings and on-site support activities prepared during the course of the contract period. The ERIM point of contact for this effort is William L. Cesarotti.

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ERIM

July 14, 1988

MEMORANDUM FOR RECORD

FROM: W. Cesarotti

SUBJECT: Technical Support of Commander's Independent Thermal Viewer (CITV) Source Selection

The purpose of this memorandum is to put into record a summary of the actions taken to date in support of finalizing the CITV and the associated Display specifications. The attached documents entitled "Comments on the CITV Specification" and "Comments on the Display Specification" summarize ERIM suggested changes to the specifications and subsequent actions taken by GDLS. In general, the review procedure consisted of the following actions: 1) obtaining a general understanding of the problem through discussion with GDLS personnel, 2) independently reviewing the documentation and developing suggested changes with supporting rationale, 3) transmitting draft comments to GDLS followed up with face-to-face discussion of the comments, and 4) providing formal reports, attached documents, for the record. Unless otherwise directed, we will continue this procedure on all document reviews.

With the possible exceptions of supporting an ambient light measurement test and reviewing the ICD, submission of the attached reviews concludes the proposed activities for Task 1.

COMMENTS ON THE CITV SPECIFICATION

GENERAL DISCUSSION:

Opening the CITV competition to FLIRs other than the Common Module (CM) FLIR requires expanding the CITV specification to provide additional performance and component definition. We understand the current CITV specification grew out of a previous CNVEO specification, and we assume this earlier CNVEO specification was predicated on CM components: optics, scan elements, detectors and scan converter. The CM components constitute the basis of a well characterized system with implicit information about image quality contained in the individual component specifications. Because the CM FLIR is no longer specified, additional information must be added to account for the implicit information associated with CM FLIR specification.

A CM approach has some shortcomings, and ERIM supports the GDLS decision to open up the bidding to non Common Module systems. We note the Government also supports this decision with the caveat, system performance specification, that the selected system must provide "as good as GPS" performance, and the final performance evaluation will include, as far as it is possible, a user direct comparison between the GPS and the CITV. Unfortunately, the performance evaluation necessitated by the system performance requirement, and differing approaches to displaying information between the GPS and the CITV (RS-330), create a major dilemma in specifying performance. The following observations created our opinion of an apparent dilemma in specifying performance: 1) GDLS will have a difficult time justifying specifications "better than GPS" even though the differences between the CITV and GPS may warrant it, and 2) the fact that production versions of the GPS have been stated to be better than the spec and these are the systems to which the CITV will be compared. Recognizing that the GPS is a CM system and the fact that there is very little quantitative data regarding its image quality, we feel that it is very important that image quality measures be included to a reasonable extent in the specification and that as much data be requested in the RFP as is necessary to evaluate these aspects of the proposed systems. Our subsequent comments have attempted to emphasize these aspects of the problem.

Since GDLS has also elected to separate the CITV display procurement from the CITV procurement, primary responsibility for the system performance lies with GDLS and not the CITV supplier. Several approaches have occurred to us which will impact this

situation: 1) Two separate acceptance criteria could be developed, one for each of the subsystems (Display and CITV) with the integration solely the responsibility of GDLS, or 2) A particular display could be specified and system performance referenced to it, placing the burden on the CITV manufacturer, or 3) The display would remain TBD with GDLS and the CITV supplier sharing the risk. The first approach may represent excessive risk to GDLS given the lack of relevant characterization information on the GPS to act as a yardstick for component specification. The second approach offers GDLS more assurance that the system specification will be met, providing the final system display is as good as the reference display. The third approach allows maximum flexibility with regard to meeting system objectives but will probably result in increased subcontract costs.

SPECIFIC COMMENTS:

Following by paragraph number of the CITV specification are recommended changes and supporting rationale for the changes. Also, actions taken on the recommendations from subsequent discussions between GDLS and ERIM personnel are presented to provide a historical record. In general, the changes suggested reflect three basic issues: (1) the need to include additional measures of image quality which will reduce the risk of accepting a non CM approach to the CTIV, (2) a number of the critical performance measures which are based on static laboratory tests cannot be obtained under certain dynamic and environmental conditions, and (3) GPS performance should take precedence wherever applicable. We recommend that, in addition to providing technical descriptions which address these specifications, additional data be requested regarding other non-specified parameters which are independent of the viewer and display, such as NETD, low frequency cut-on, dynamic MRT, channel to channel non-uniformity, optical distortion or scatter plots with qualifications of whether the data are measured or theoretical. Proposed enhancements should be explained in detail and evaluated for their potential operational use and effectiveness. An explanation of how the data are processed from the detector to the display would prove very enlightening and may disclose some potential problems which might not surface until after the hardware is fielded. This additional information would assist GDLS in evaluating the responses in the event that several bidders present similar proposals. Also, it may be of interest to GDLS if the CITV contractors are encouraged to propose changes to certain potential cost drivers which would not significantly reduce mission effectiveness but would greatly reduce costs.

PARAGRAPH 3.2.1.5:

Change: Aspect ratios between 2:1 and 4:3 are acceptable. The minimum vertical NFOV will be 2.5 degrees and the minimum vertical WFOV shall be at least 7.5 degrees.

Rationale: The GPS has a 2:1 aspect ratio. This does not prohibit the use of RS-330 and can provide advantages such as no symbology overlay on imagery, no requirement to fill in additional vertical lines, more horizontal information with fixed number of detectors in vertical (CM), etc.

Action: No change was made in spite of arguments concerning symbol overlays obscuring scene detail. GDLS held to the 4:3 aspect ratio based on user feedback concerning empty parts of the display and the fact that there is very little symbology on the CITV display.

PARAGRAPH 3.2.1.6.1:

Change: The optical centerline of the narrow field of view (NFOV) at zero elevation shall maintain alignment parallel to the CITV mounting reference within 0.1 mil at any azimuth angle while in any operating mode.

Rationale: Clarification of specification.

Action: No change was made since it was felt that no clarification would be necessary as a result of details included in a drawing which is part of the specification.

PARAGRAPH 3.2.1.7.1:

Change: Application or removal of power shall not cause damage to the CITV. Removal of power shall not result in movement of the CITV sensor head. During power down, the sensor head shall not drift more than 1 mil and shall suffer no damage from vehicle dynamics specified herein.

Rationale: Removal of specification for platform lock down reduces complexity and cost of the sensor without loss of performance or increasing risk of damage.

Action: This had already been reworded to specify only that the sensor would hold its position within one degree without damage upon loss of power.

PARAGRAPH 3.2.1.12:

Change: Clarification required. (The CM spectral response is 7.6 to 11.76 microns. Does this specification imply the 50% points at 8 and 12 or anywhere within those limits?)

Action: This was changed to restrict spectral radiance to a band within the 7.5 to 12.5 spectral window. This restriction was considered necessary to eliminate possibilities of sun glint in the 3-5 micron region.

PARAGRAPH 3.2.1.13:

Change: The geometric distortions attributed to the CITV shall not exceed 2% in either the horizontal or vertical directions over the entire field of view.

Rationale: The RS-330 specification for distortion is ±2%. The distortion for the GPS is not known. The recommended value guarantees that the distortion due to the CITV is no greater than that of the display.

Action: This change was accepted as a reasonable requirement given the lack of a clear-cut measure of GPS performance and the fact that it is a 4:3 aspect ratio as opposed to a 2:1 aspect ratio.

PARAGRAPH 3.2.1.15:

Change: The CITV shall provide a standard composite differential video output signal conforming, as a minimum, to RS-330 EIA. The scene video shall present no optical reversion or inversions. The dynamic range of the video output shall be at least 36 dB for any CITV gain adjustment. The video bandwidth shall be limited to achieve optimum signal to noise ratio without degrading high frequency MTF.

Rationale: Most of the specification referred to RS-330 specifications and can be left out. The dynamic range of GPS was not known. This specification represents a 6 bit system (13 shades of gray) which can be achieved with only a moderately good display.

Action: The dynamic range requirement was changed to 36 dB commensurate with higher quality displays.

PARAGRAPH 3.2.1.17:

Change: The overall MTF of the CITV as measured at the video output shall meet the requirements of Table 1, and shall be greater than 26% at 3.3 cycles/milliradian.

Rationale: Make consistent with Table 1.

Action: A similar change had already been made.

PARAGRAPH 3.2.1.18:

Change: The required MRT over 50% of the total central area of the field of view shall be less than or equal to that given in: 1) Table IIa for the horizontal MRT in the NFOV mode; 2) Table IIb for the vertical MRT in the NFOV mode; 3) Table IIc for the horizontal MRT in the WFOV mode; and 4) Table IId for the vertical MRT in the WFOV mode when using a display that meets the requirements of specification SB-SA17310.

Rationale: Variations in MRT resulting from horizontally vs vertically oriented targets, off-axis operation, and field of view change should be considered. It should also be noted that initial detection often occurs in the wide field of view.

Action: The use of 50% of the total area was clarified. The inclusion of plots for both vertical and horizontal and for NFOV and WFOV was rejected since GDLS had no vertical MRT data and stated that the WFOV was rarely used in a search mode.

PARAGRAPH 3.2.1.18.1 (Dynamic Range):

Change: MRT targets at the mean spatial frequency/temperature differential specified in Table IIa through d shall be resolvable at an ambient temperature of 20°C and again at an ambient temperature of 40°C (or an upper temperature compatible with the GPS, if greater) without commanding any readjustments of the sensitivity or contrast controls. A minimum of 10 shades of grey ($\sqrt{2}$ factor per shade) will be maintained during the changes in temperature.

Rationale: The dynamic range specified seems large. This specification suggested is reduced but requires a minimum dynamic range equal to that of the GPS.

Action: The requirement was not changed; however, the test was rewritten to measure the desired performance parameter.

PARAGRAPH 3.2.1.19 (Uniformity):

Change: Non-uniformity on the display such as caused by internal reflections, variable emission of the housing, detector channel droop, channel to channel non-uniformity, vignetting, and other noise not originating from the detector shall not be perceptible at the video output for the maximum contrast and midrange brightness settings.

Rationale: Insure overall image quality.

Action: Additional wording was added to include other sources of non-uniformity; however, the title was not changed.

PARAGRAPH 3.2.1.20 (Signal Transfer Function):

Change: The relationship between the input radiance and the output shall be monotonic for all contrast and brightness settings.

Rationale: This will guarantee that objects which are hot or cold do not inadvertently change polarity (thereby confusing the operator), but will allow for optimization of the display for human viewing by redistributing the input levels (Gamma Function).

Action: This specification was added.

PARAGRAPH 3.2.1.38:

Change: The CITV shall contain both a set of local controls and allow for remote control from a 1553B data bus. Each local control shall have an equivalent remote command. These controls/ commands shall consist of the following functions and will be described in the interface document ICD SA -17300.

Rationale: It seems appropriate for test purposes and consistent with the concept of graceful degradation that the CITV should not be entirely dependent on the 1553B data bus.

Action: This suggestion was rejected based on the argument that any local controls would be inaccessible to the operator.

PARAGRAPH 3.2.1.38.1 (Sensitivity - Contrast):

Change: Clarification only.

Action: The original wording was maintained but the title was change to Contrast.

PARAGRAPH 3.2.1.38.3:

Change: Brightness A command shall be provided by which the average amplitude of the video signal can be varied. Sufficient range shall be provided to adjust the average video from black to saturation.

Rationale: This and the previous paragraph are for clarifying contrast vs brightness.

Action: The new wording was accepted, but the title was changed to Sensitivity. A memo was generated concerning this change. We also asked that the word "Contrast" be added in parentheses after the title.

PARAGRAPH 3.2.1.39:

Change: The CITV shall provide the following operating status indications locally and via the 1553B data bus and data link interface.

Rationale: Same rational as in Paragraph 3.2.1.38

Action: Again it was felt that any local status indicators would be unavailable to the operator.

PARAGRAPH 3.2.1.39.2:

Change: An indication shall be provided to identify when there is an LRU fault, and which one.

Rationale: It is also necessary to know which one has failed.

Action: This change was included.

PARAGRAPH 3.2.1.40 (Lens fogging and condition):

Comment: What is the "state of the art" protection against fogging of external optics?

Action: No individual was available to comment on this suggestion.

PARAGRAPH 3.2.4.6.1.2:

Change: ADD-- It is desirable from an operational viewpoint to differentiate between a warm reset and a cold reset. The BIT will be performed only after a cold reset or upon initiation.

Rationale: Otherwise every time there is a low voltage or momentary power supply interruption as might occur during the heat of battle, the system will be tied up for 20 seconds or until the operator intervenes. Under repeated shocks, the CITV may have little operational time if BIT is performed every time there is a loss of power.

Action: This had previously been reworded.

PARAGRAPH 3.2.4.6.2.1:

Change: Insert before the last sentence.-- A failure shall be signaled by an ACTIVE HIGH level ("1").

Rationale: To eliminate any ambiguity over what signal level indicates a failure and to be consistent with the concept of "OR"ing the results from each LRU.

Action: This was information which would be contained in the ICD.

PARAGRAPH 3.2.4.6.3:

Change: Delete item (e).

Rationale: If it is necessary, improves maintainability and meets other constraints, then what is the problem?

Action: Item (e) was included as a flag to the developer to indicate that, although BIT is important, it should not dominate development or production costs and hence would not be deleted.

PARAS 3.2.5.2,.3,.4,.5,.12,.13,.15,.18:

Change: Eliminate requirement to meet requirements of 3.2.1 during tests.

Rationale: Many of the specifications of 3.2.1 are for the static performance only, and are also unreasonable during tests with airborne particles.

Action: These items had been reworded to eliminate the static performance requirements. The original intent was only to verify that the system continued to operate although some loss in performance would be acceptable.

PARAGRAPH 3.2.5.6:

Comment: Recommend testing of added specifications 3.2.1.19 and 3.2.1.20

Action: The new test was added in 4.2.1.20.

PARAGRAPH 4.1.5:

Change: Add test in 4.2.1.20 to Table in 4.1.5.

Rationale: Completeness.

Action: The table would be updated to include the new test.

PARAGRAPH 4.2.1.5:

Comment: This procedure seems inordinately difficult. We feel much simpler tests could be devised.

Action: This change was not significant since the test details were not critical but would be defined later after the CITV contractor was on board.

PARAGRAPH 4.2.1.7.2 (Grounding):

Change: Apply 28 ±2vdc for a time period of two minutes between the input power return and the assembly housing. Verify that the resistance between is greater than 10 megohms to verify conformance with paragraph 3.2.1.7.2.

Rationale: 100 volts may be excessive given input power specifications and can be lethal. Very little is lost by reducing the test voltage unless the breakdown voltage is critical and if so it should also be specified.

Action: It was agreed that given some of the other specifications on the input prime power this requirement was not that unreasonable depending on how the test was performed and hence no change was made.

PARAGRAPH 4.2.1.18.1:

Comment: Test specifications should reflect changed limits of specifications cited in 3.2.1.18.1.

Change: (Insert after first sentence.) The mask temperature will be made equal to the background by using a mask and a collimator which are sufficiently large to fill the field.

Rationale: This will ensure that the average level tracks the mask temperature and hence will have no effect on the AC coupled performance.

Action: This change was made after discussions which revealed the intent of this specification.

PARAGRAPH 4.2.1.19:

Change: The CITV entrance will be covered with a highly diffuse and absorptive material in the LWIR band and the system adjusted for maximum contrast and midrange brightness. The thermal display shall be observed from any discernible image persistence or vibration of the raster lines to verify conformance to 3.2.19.

Rationale: The cover must be thermally uniform in order to detect non-uniformities in the display. Non-uniformities will be accentuated at maximum gain (contrast) and the level (brightness) should be at mid range to allow maximum deviations above and below the average.

Action: The only change which was made concerned the setting of the contrast and brightness, which in this case were used as gain and level, respectively. Again, further clarification of the terms Sensitivity and Contrast is advisable, and this test requirement would also be affected by any reinterpretation of the terms Contrast and Sensitivity. Furthermore, it is probably appropriate to indicate at which gain setting this test would be made.

PARAGRAPH 4.2.1.20 (Signal Transfer Function Test):

Change: A collimator and an extended blackbody source (non-field filling) are used. The source is varied from black saturation to white saturation. A plot of the difference in signal amplitude between the source and background should change monotonically with temperature.

Rationale: This test is proposed as a demonstration of the specification in 3.2.1.20

Action: This test was included as written.

PARAGRAPH 4.2.1.24.1:

Change: The source shall then be activated to provide a signal at least a 100:1 S/N ratio at the output of the irradiated channel.

Rationale: As originally stated, a 10% change due to crosstalk would be on the same level as the rms noise and virtually indistinguishable from the noise.

Action: The S/N ratio requirement was changed to 100:1.

FOLLOW-UP COMMENTS:

After further consideration of the current CITV Specification, we feel that the following two additional changes should be considered for the present specification or as a future amendment to the specification:

1. Further clarification of the terms Contrast and Sensitivity, and

2. Inclusion of at least one additional specification - Sensor Frame Rate.

These recommendations arise from our concern that a confusing or incomplete specification could result in the delivery of a system which is incompatible with the intent of the specification.

In reference to Item 1:

There appears to be some confusion about the accepted definitions of Contrast and Sensitivity. Our understanding based on conversations with GDLS is that there are two controls on the GPS which control the Gain and Level of the sensor output; in the 27 June version these were labeled, respectively, Sensitivity and Contrast. It was subsequently stated that these were reversed from their actual meaning as per a TRU document. Television uses the terms Contrast and Brightness to denote Gain and Level, respectively. It is interesting that TI (a common module vendor

and major government supplier of IR systems), in its comments of 4 May, appeared to be comfortable with the 27 June definitions. There seems to be considerable confusion as to the appropriate use of these two terms.

It would seem that further efforts to resolve this confusion are appropriate since these terms are used to denote relevant setup conditions for certain tests (such as the dynamic range and spurious signal measurements) which will be used to evaluate the performance of the CITV. I would suggest that such information would be available in a Technical or Training manual for the GPS or from someone at NVL.

In reference to Item 2:

As currently written, a frame rate other than 30 Hz is acceptable. If there may be contractual problems resulting from excluding a bidder based on these criteria, then it would be worthwhile to include this as a primary specification. This same logic could extend to Scan Interlace (2:1) and Scan Accuracy, although these latter parameters will be folded into the static MRT measurement. Once again these are parameters which are well defined under the umbrella of Common Module but have been overlooked in this specification, which doesn't come under the protection of that umbrella.

COMMENTS ON THE DISPLAY SPECIFICATION

GENERAL DISCUSSION:

Our initial impression of this specification was that design guidance/direction was included as part of the specification. In our opinion the specification should address form, fit, and performance only. Design is a potential supplier responsibility, and by including what would be considered design specifications, i.e., maximum brightness, dynamic range, uniformity, and reflectivity, the possibility of under or over specification and risk to GDLS is enhanced. Several of the specific comments on this specification suggest changing the apparent design specifications to a performance specification, i.e., meeting resolution requirements over the range of ambient light conditions.

The high level ambient lighting conditions place the most severe requirements on the performance of the display as a day/night viewer, and the ambient light performance specification will be one of the more difficult specifications to meet, especially when combined with the other constraints, e.g., resolution, contrast, etc. A test to record ambient light levels is recommended to insure the specification value is no higher than is necessary and a measurement is appropriate.

SPECIFIC COMMENTS:

The following suggested changes regarding the CITV display were discussed on 8 July '88 with Sabha Meir.

PARAGRAPH 3.1:

Change: Recommend use of either the numbers or at least the same terminology to refer to high and low ambient conditions.

Action: Accepted.

PARAGRAPH 3.1.1.2.1:

Change: (1) Recommend that the uniformity be specified as in the CITV, i.e., there shall be no perceptible non-uniformities at maximum contrast for all brightness levels.

(2) The first line should be changed to read: The maximal light output of the CITV display shall be consistent with the performance specified in paragraphs 3.2.1.1.3 and 3.2.1.1.4 .
(3) The last part concerning the Dot Matrix display should be in a separate paragraph and/or labeled.

Action: Accepted.

PARAGRAPH 3.2.1.1.2.2 (Brightness and Contrast Controls):

Change: (1) Recommend that the brightness and contrast controls should be in separate paragraphs and that the brightness control should be specified like the contrast, i.e. that it should be adjustable to the minimum and maximum required value.
(2) The contrast control should also be linear.
(3) There was a question as to the maximum display brightness to meet security levels during silent watch. GDLS action to find out the actual value.
(4) It is suggested that the 1 M Ohm input impedance will introduce noise into the display and that either a current drive control or a lower impedance input would be appropriate (1-10 K Ohm).

Action: Accepted.

PARAGRAPH 3.2.1.1.3.1:

Change: It was noted that the contrast ratio was not very explicit and not necessarily indicative of the performance of the display. It was suggested that terminology either be defined or a reference be provided (in this case the book, Flat Panels Displays and Crts, by Lawrence E. Tannes, Jr.) and that the term "detail contrast ratio" be used instead. Additionally, there was a question as to whether the 1/3 ftL would meet low level light emissions requirements for silent watch. Again, all references to Dot Matrix displays should be in a separate paragraph.

Action: Accepted. GDLS action to determine minimum brightness.

PARAGRAPH 3.2.1.1.3.2:

Change: (1) Recommend using the term "detail contrast ratio".
(2) All references to reflectivity, polarizers and spectral filters should be deleted. The methods which are used by the supplier to meet the requirements are immaterial provided that the

display meets all performance specifications. Furthermore, it is the responsibility of GDLS to make the specs realistic.

(3) The reference to 64 grey shades should either be deleted or changed to 13 to be consistent with the numerous uses of a Log-Reflectance scale elsewhere in this document.

Action: Accepted.

PARAGRAPH 3.2.1.1.3.3:

Change: We strongly recommend that the value used here be measured. The present value of 3000 ftL seems exceptionally large for a system which is inside of an enclosure which minimizes paths to the outside. This value is more indicative of direct sunlight. A hatch open state during a daylight battle does not seem feasible. Also, change contrast ratio to "detail contrast ratio".

Action: Accepted. GDLS to arrange for measurement of ambient lighting.

PARAGRAPH 3.2.1.1.4:

Change: Use the word "high" instead of worst. Use "maximum brightness" in place of 100 ftL.

Action: Accepted.

PARAGRAPH 3.2.1.1.13:

Change: It was noted that requirement of no off axis degradation was probably unrealistic. It was recommended that no degradation would be allowed out to 20 degrees with degradation up to 20% at 50 degrees off axis.

Action: Accepted.

PARAGRAPH 3.2.1.2.1:

Change: Define "peak_to_peak" which is usually written "p-p".

Action: Accepted.

PARAGRAPH 3.2.1.2.5:

Change: Specify the load which should be driven (75 ohms) and what type of driver (Differential or Single ended).

Action: Accepted.

FOLLOW-UP COMMENTS:

Following is a tabular comparison of the GPS display and the CITV display. Based on available information, this comparison leads us to believe that the CITV system cannot possibly be "as good as" GPS because many of the GPS display parameters are better than those of CITV. What is not clear from this qualitative assessment is: How much worse is it? Recognizing that acceptance will be based on a subjective evaluation under field operating conditions, it is difficult to conceive that the assessment/evaluation will be favorable.

GPS	CITV
Controlled Ambient Illumination	Uncontrolled Ambient Illumination
Controlled Surround	Uncontrolled Surround
Low Brightness/Low Power	High Brightness/High Power
Wider HFOV (2:1)	4:3 Aspect-Raster Modulation
8:1 Magnification	6:1 Magnification
Controlled Magnification	Uncontrolled Magnification
Vertical Raster (Implies Better Vertical MRT)	Horizontal Raster
Infinity Focus (High Acuity)	Min Acceptable Focus (About 15" away from display)
MRT--"Better than Spec"	Spec MRT is Acceptable
Eyepiece Display	Flat Display

A major question is: "How far from ideal are the viewing conditions?" This can be reduced to the following question: What is the maximum probable ambient light condition? This information is also very important for specification of the display, and we strongly recommend that some actual measurements be made on a sunny day. Two measurements are of interest, requiring a small mirror, a photometer (photographer's light meter) and an Abrams tank outdoors with the hatches closed:

1) Test for direct sunlight -- Place a mirror at the location where the CITV display will be placed and see if you can see the sky and estimate the probability that the sun will be positioned appropriately to be seen.

2) Measure reflected illumination -- Place a photometer in front of the CITV location facing away from the CITV display and take several measurements at and around the CITV display (ambient surround).

ERIM

July 19, 1988

MEMORANDUM FOR THE RECORD

FROM: W. Cesarotti

SUBJECT: Technical comments on ICD-SA17300, dated 21 June 1988

Following are technical comments in reference to the ICD-SA17300 for the CITV to the Block Improved Abrams Tank dated 21 June 1988. Since the ICD is in a preliminary stage of development with many items identified as TBD, only two general recommendations can be provided at this time.

1) Recommend providing hierarchical interconnect and cabling information for the Commander's Integrated Display (CID). An example of a hierarchical interface definition, including an example signal specification, is attached. For specification of each individual electrical connection, the following additional information should be added:

Source
Destination
Type (bi-directional, Tri-state, etc.)
Drive impedance
Load impedance
Frequency
Direction
Technology (TTL, ECL, Analog, etc.)
Timing diagrams
Special terminations

2) Recommend including a provision for the human interface, i.e. how big are the control knobs and how do they operate (what is the relationship between movement and the change in variable). A programmer will need to know how the controls function; are they toggle switches (on/off or up/off/down), are they setpoints? Should the control be sensitive to rate of change? What is the allowable latency of the control? Who will take the lead in defining the data structures and data formats? How will exceptions be handled? The sizing of the software task will depend significantly on answers to these questions. The cost of software will depend significantly on the volatility of these answers.

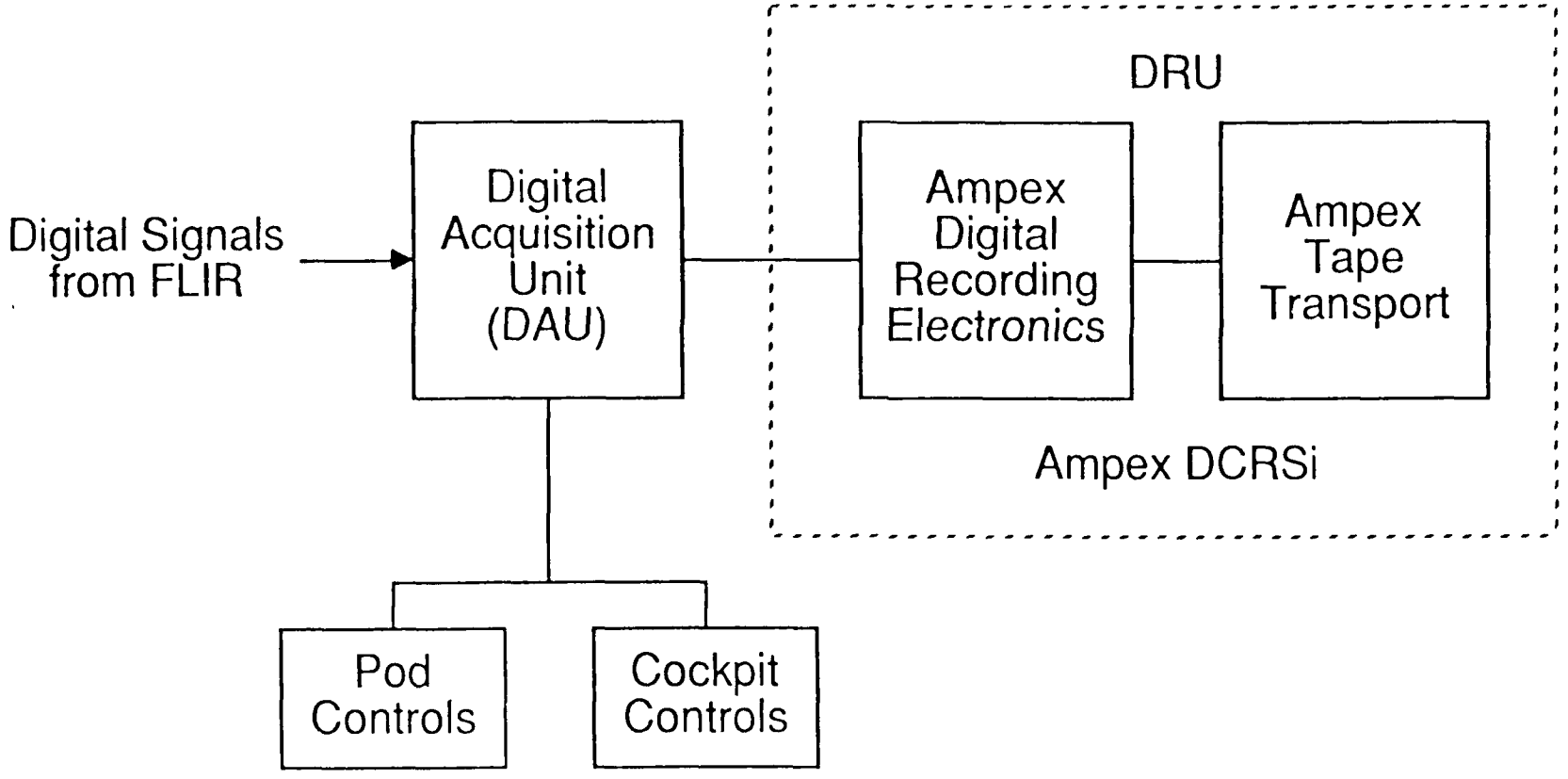
Some of the information recommended for inclusion exists in the CID specification; however, in this case redundancy is valuable in that all necessary interface information will be in a single document.

Attachment

EXAMPLE

HIERARCHICAL INTERFACE DEFINITION

DIGITAL RECORDING SUBSYSTEM (DRSS) BLOCK DIAGRAM



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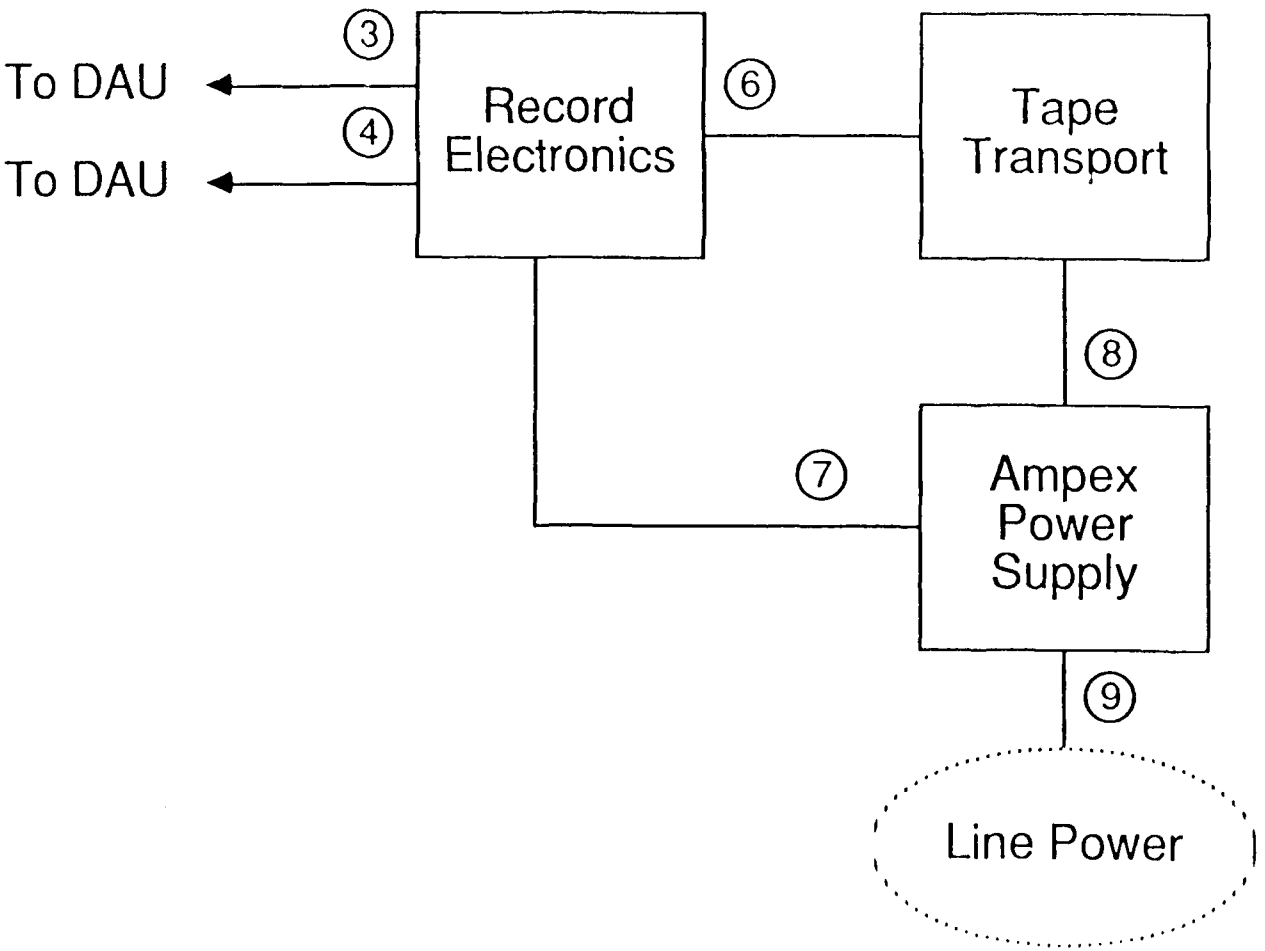
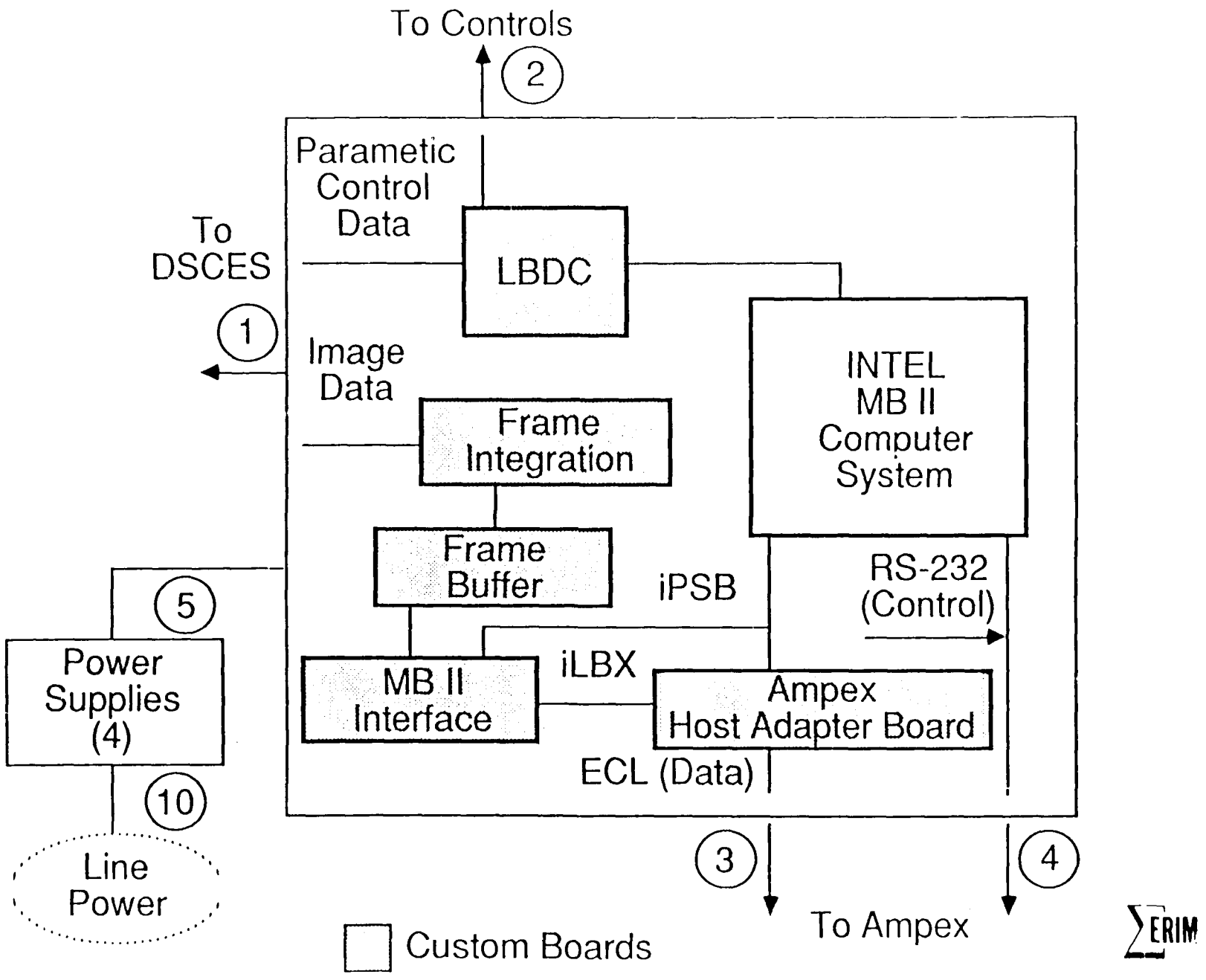
EXAMPLE: TOP LEVEL

DRU WITH CABLES



EXAMPLE: SECOND LEVEL INTERCONNECT

DAU WITH CABLES



EXAMPLE: SECOND LEVEL INTERCONNECT

DRSS CABLES

Cable	Connects	Signals	Connector
1	DAU/DSCES	Digital Video Data; LBDC Data	
2	DAU/Control Panels	*TBD*	
3	DAU/Ampex Electronics	Image File Data	
4	DAU/Ampex Electronics	Control & Status Information (RS-232)	
5	DAU/DAU Power Supply (PS)	Power for DAU	
6	Ampex Record Electronics/ Ampex Tape Transport	Image File Data	
7	Ampex Record Electronics/ Ampex Power Supply (PS)	Power for Record Electronics	
8	Ampex Tape Transport/ Ampex PS	Power for Tape Transport	
9	Line Power/Ampex PS	Line Power	
10	Line Power/DAU PS	Line Power	

EXAMPLE: SECOND LEVEL INTERCONNECT

EXAMPLE: THIRD LEVEL INTERCONNECT*

Signal Name	:	TEC HOT 8	
External ID	:	LBDC024	
Internal ID	:	RECORD 039	
Signal Type	:	DIG TTL	
Tri-state?	:	NO	
Frequency	:	DISCRETE	
Duty Cycle	:	N/A	
Voltage Range	:		
Source LRU(PWB)	:	TBD	See Note 1
Dest. LRU(PWB)	:	FCP(SIO), (V,R,O)	See Note 1
Conductor Type	:	TBD	See Note 2
Cond. Gauge	:	24	
Start Station	:	W2 & W3 ?	See Note 3
Finish Station	:	W2 & W3 ?	See Note 3
Source Z	:	TBD	
Destination Z	:	54LS166	
Max Voltage	:	+5	
Max Current	:		
True Volt	:		
False Volt	:		
Remarks	:	BLACKBODY TEMPERATURE DATA	
Timing	:	See page 11, Note 4	

NOTES:
1. [V] indicates source or destination during normal viewing; [R] indicates source or destination during record mode; [P] indicates source or destination during playback.
2. TSP indicates twisted, shielded, pair.
3. W1 is the wiring harness that interconnects the Scanner Head Assembly and the DSCES. W2 is the harness that interconnects the DSCES and the operator interface. W3 interconnects the DSCES and the DRU.

* Third level detail includes cable schematics, timing diagrams, terminations and mechanical drawings.

ERIM

August 1, 1988

MEMORANDUM FOR THE RECORD

FROM: W. Cesarotti

SUBJECT: Ambient Light Measurements

The purpose of this memorandum is to put into record a summary of the ambient light measurement tests conducted on 21 July 1988 in support of development of the Commander's Independent Display (CID) specification. Following is a description of the test, summary of results, analysis of results, and recommendations:

Ambient Light Measurements

The ambient light measurement test was conducted inside the Abrams tank, the Integrated Commander's Weapon Station (ICWS) with 360 degree vision blocks, at the location of the CID. The test consisted of two separate measurements: 1) to detect if full sunlight could illuminate the display, and 2) what were the ambient light conditions with hatches open and closed. A mirror was held 2-3 inches below the ceiling and 1-2 inches to the right of the GPSE at the approximate location of the CID. There were no clouds and the measurements were made between 10:30 and 11:30 AM at the Warren Logistic Facility with the sun in back of the commander's station. Several different instruments were used for the light measurements as a means of comparison, although only the unit made by Weston and furnished by GDLS was calibrated (CDP 0103787/GDLS 12-29-87 and EIL #575220 by KW of Weston on 12-29-87). Additional units furnished by ERIM were the Weston Master II, Luna Pro, and Norwood. Present at the test were R. Mousseau, R. Kern, N. Hahka, S. Meir of GDLS and R. Watts of ERIM.

Results--Direct Sunlight

The test for direct sunlight was made by observing if the sky could be seen in the mirror and measuring the illumination. It was observed that direct sunlight could arrive at the surface of the display with the hatches open or closed. With the hatches open, the sun could fully illuminate the display but at a fairly large incident angle from either the left or right side. Direct light could not reach the display from behind because the hatch

itself acted as a shield in its open position. With the hatches closed, it was also observed that direct sunlight could reach the display but only after it had passed through the vision blocks and had been reduced to a strip about 1 to 1.5 inches in height so that only a portion of the screen would be illuminated at any one time. Once again, incident sunlight was at a fairly large angle such that for a flat surface the light would not be reflected into the commander's eyes. The geometry of the display with respect to the direct sunlight is detailed in the subsequent analysis. The measure of the direct sunlight level of illumination by all test meters was off-scale. Off-scale indicates a value greater than 1600 ft.c.

Results--Ambient Illumination

Measurements of the ambient light incident on the display were made by placing the sensitive surface of the meter in several locations where the CID would be located. With hatches closed, the following peak measurements were made at the display:

Weston (calibrated)	20 ft.c
Norwood	15 ft.c
Weston Master II	15 ft.c
Luna Pro	8 ft.c

With hatches open and no direct sunlight at the display location, the following peak measurements were made at the display location:

Weston (calibrated)	100 ft.c
Weston Master II	100 ft.c

The Weston Master II was also used to measure the reflected ambient light incident to the location where the commander's eye would be for normal viewing, to assess the ambient surround. The observed value was 30 ft.c; not surprising because the commander looks away from the source of illumination while the display would face the source of illumination. Although it is also possible that the sun could be in the commander's eyes during certain times of the day, there is ample room for the commander to position his head to alleviate this condition.

Analysis and Recommendations for the Direct Sunlight Condition

Analysis

Two figures are attached which show an estimation of the probability of having direct sunlight illuminate the display while the hatches are closed. For Figure 1, it is assumed the turret has equal probability of being in any rotational position with respect to the sun -- accounting for the 360 degrees in the denominator. Of this 360 degrees, only 85 degrees represent a position where the sun could pass via one of the vision blocks and hit the display. This angle represents the angle between the first and last rays to touch the screen and takes into account that the incident beam is not a point. As shown in Figure 2, the angle of incidence is likely to be on the order of 25 degrees with respect to the surface normal -- assuming that the face of the display is vertical. Also, since the rays from the sun are essentially parallel, the size of the beam is the clear aperture of vision block projected onto the display. The angle shown in the side view can be related to the hours during which the sun could shine directly on the display given the season and latitude. Based on the estimates used, it is possible that at the polar regions (greater than 85 degrees latitude), during the summer and on clear days, the sun will be within this angle 24 hours a day. For latitudes below 50 degrees this number is more likely to be on the order of 2-4 hours per day throughout the year.

In summary, the ambient lighting conditions at the display location, even with hatches open, are quite low (less than 100 ft.c). However, it is possible that a rectangle with a height of 1 to 1.5 inches of direct sunlight can illuminate the display. The probability of direct illumination is less than 24% during those hours when the sun is in a position to directly illuminate the CID. The sun will be in such a position nominally 2-3 hours per day at latitudes below 50 degrees. This time can increase appreciably during the summer months near the polar regions.

Recommendations

GDLS has several options available:

1) More exact calculations are possible if more accurate information regarding the geometric relationships is made available. This may be essential if the conclusions drawn from the test critically impact operational performance, the display design, and specification. In general, we recommend supplying the display manufacturer

with drawings which show the important geometrical relationships, including the possible positional variation of the commander's eye.

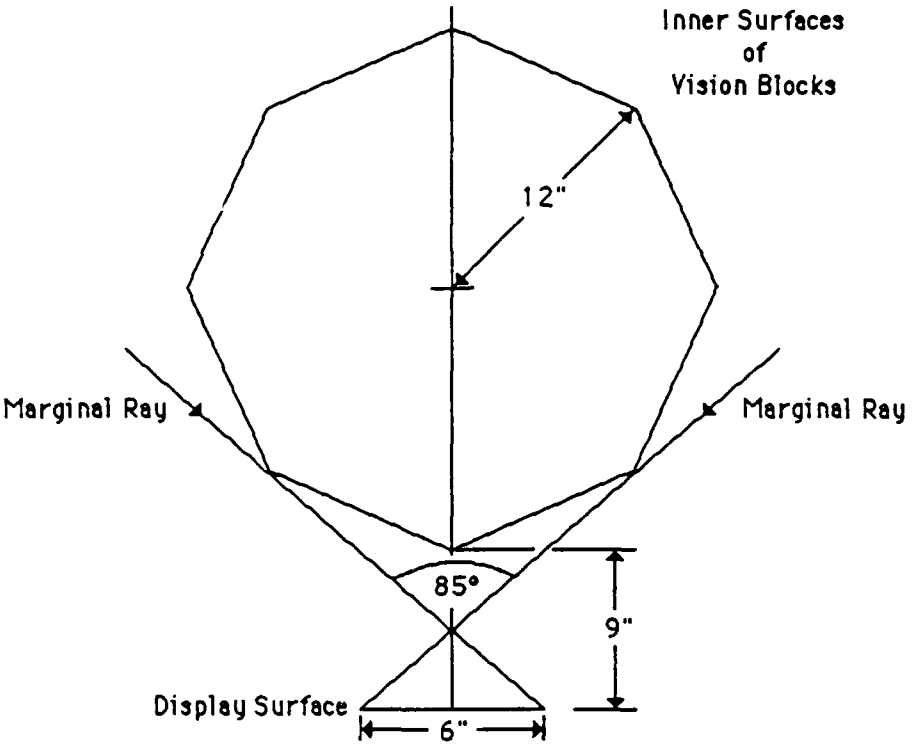
2) Full operational performance in direct sunlight can be specified. This option appears to be the least desirable as it requires a significant design (cost) effort to alleviate a problem which will occur very infrequently.

3) Acceptable performance (lower than full operational performance) in direct sunlight can be specified.

4) Operation in direct sunlight can be requested and costed as an option, with the display manufacturer providing anticipated performance at additional cost.

5) Ask the Army to make an operational assessment of these conclusions, and proceed on their recommendation.

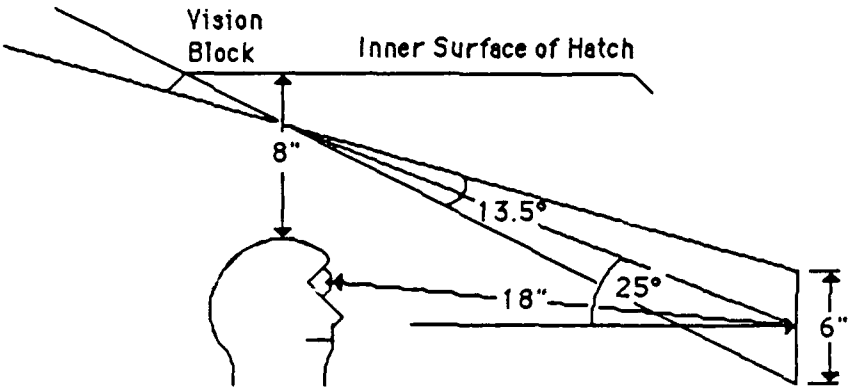
6) Modify the ICWS vision blocks to include flaps which can be readily open or closed. This has the added advantage of allowing secure operation with the lights on inside the turret or with a reasonable brightness on the display. This option is beyond the scope of the CID; however, it eliminates an intermittent but significant problem, probably creates only a minor operational annoyance, and can be accomplished with minimal design effort.



The sun must be within the 85° azimuth wedge to fall directly on the display.

$$\%\text{probability} = \frac{85°}{360°} \times 100 \cong 24\%$$

Figure 1: Direct Sunlight Through Vision Block - Top View



note: Dimensions are estimated

1.) Time exposed to direct sunlight assuming 12 hours of daylight:
$\frac{13.5°}{180°}$ x 12 hours = 0.9 hours

2.) *This occurs twice each day.*

3.) Depending on latitude, season and actual angles this time could be much longer (6-8 hours at 70° lat. in summer) or shorter (0 hours above 68.5° lat. in winter). It would be equal to the time which the sun spends between 18°-32° with respect to the horizontal.

4.) The sun forms a 1-1.5" stripe on the display. The display will never be fully illuminated by the sun.

Figure 2: Direct Sunlight Through Vision Block - Side View

ERIM

August 16, 1988

MEMORANDUM FOR THE RECORD

FROM: W. Cesarotti

SUBJECT: Suggested Approach for CITV Source Selection

The purpose of this memorandum is to provide a suggested approach to the evaluation of the performance and technical maturity subsections of the technical section of the CITV source selection. By direction, this suggested approach is an independent look and recommendation to any plans previously established by GDLS technical personnel. The suggested approach is described in the following attachment. Additionally, three source selection procedural recommendations are provided for consideration.

GDLS technical personnel requested that ERIM identify the technical areas it could participate in for source selection; those areas are marked in the text with an (E).

/bmf
Attachment

ERIM

RECOMMENDATIONS ON CITV SOURCE SELECTION

GENERAL APPROACH

The basic proposed approach uses the standard technique of preparing a matrix score sheet in which scores are given for each specification item, and each specification item is assigned a weight based on relative importance to system performance. The sum of the scores multiplied by the respective weights combine to give a total score. To prevent any one category (technical, cost, ILS, management) from dominating the total proposal scoring, normalizing each section to the maximum allowable points is recommended. Additionally, each specification item should be scored by more than one evaluator. Scoring guidelines and suggested weightings are presented and discussed in the following sections for the performance and technical maturity subcategories, and an example of the suggested scoring system is attached.

For the two technical subcategories (performance and technical maturity) being addressed in this paper, we recommend weighting performance nominally three to four times higher (70% - 30% to 80% - 20%) than technical maturity. The recommendation is based on the rationale that system performance is the primary requirement of the Government, and with the given schedule, it is difficult to believe any serious contractor would propose a totally immature technology. However, technical maturity must be addressed because it is the primary element in judging schedule risk.

The CITV is a subsystem of the overall Block Improvement Abrams effort, and as such, there are several specification items that must be met without qualification. For this reason, we recommend a two-step approach to evaluation. The first step will be to review the essential items that must meet specification to be considered responsive; i.e., if a bidder does not state he will meet these specifications and explain how he will meet them, the proposal will be dropped from further consideration. After the minimum essential specifications are satisfied, the proposal will be evaluated according to the aforementioned score sheet. It is important to identify these minimum essential specifications to potential bidders and provide instructions requiring that they state their ability to meet these specifications with sufficient supporting rationale to remain in competition. Following is a list of those specification items that are assessed as essential specifications and, in correspondence with potential bidders, the specification paragraph numbers should be identified with each item:

Size
Fit
At Least Two Fields of View
FOV Alignment
Spectral Region
360 Degrees Rotation
1553B Databus
Gain Control
Polarity Switch
Missing Lines
B Spec MRT Curve
RS-330 Output
No Image Inversions or Reversions
Engage Lock During Power Down
Independent Surveillance
Gun Line of Sight
LOS Position Signal
LOS Synchronization
Stabilization
Mil Std Materials and Workmanship
Ballistic Protection
Fault Isolation to the LRU
Minimum MTBF and Maximum MTTR

PERFORMANCE EVALUATION

The evaluation of performance should focus on overall system performance. This is accomplished by establishing: 1) weighting factors on each specification item based on importance to system performance, and 2) item scoring guidelines based on the evaluator's opinion of the effect on system performance of exceeding, meeting, or failing to meet specifications. Establishing weighting factors can and must be accomplished prior to starting the evaluation, and the weighting factors can be determined through a consensus of engineering judgment. Scoring is the responsibility of the evaluator who must assess system performance through technical specifications to select a rating. To make this judgment, it is desirable to have an accepted definition of required system performance as well as "desirable" enhancements that are not specifically required. Examples of a system performance definition, a scoring system, and suggested weighting factors (with rationale) are presented in this section for each specification item.

System Performance Definition

The tank commander's night vision capability is presently restricted to using the Gunner's Primary Sight Extended and vision

blocks, and hence, the commander's thermal viewing capability is limited to what the gunner sees. The purpose of the CITV is to provide the commander with an independent thermal viewer with the option of firing the gun or handing the target off to the gunner. Once a target is handed off, the commander could continue to look for targets. It would be ideal if the CITV was as effective as the GPS for targeting, but it is probably sufficient that it is almost as good with more emphasis on the handoff since firing is a redundant operation. Based on this interpretation, it is reasonable to place greater emphasis (higher performance scoring and specification weighting) on the finding of targets rather than on the actual sighting of the gun.

Example of Performance Scoring Guidelines

Each rater would score each item according to the scale shown below. To assist in documenting the final evaluation, for scores below four or above six, comments or rationale should be provided.

Rating	Definition
0	Major deficiency which cannot be corrected without a major change to the proposal.
1	A major deficiency or not addressed and could be corrected.
2	A deficiency in meeting requirements and the system performance is substantially degraded.
3	A deficiency in meeting requirements and the system performance is below expected standards.
4	Slightly below requirements although the deficiency is not significant to system performance.
5	Meets all requirements as written.
6	Slightly exceeds requirements although the benefits are not significant to system performance.
7	Exceeds requirements with possible improvement in overall system performance.
8	Exceeds requirements with a definite improvement in overall system performance.

9 Exceeds requirements with a substantial benefit to the overall system performance.

10 Exceeds all requirements. A truly superior design which is of substantial benefit to overall system performance.

Suggested Weighting Factors for Performance Items

The Qualification Matrix for the CITV was reviewed in relation to the above system performance definition, and the following table reflects our opinion of the importance of each specification item to the system performance of the CITV through the weight factors shown in parentheses. The weighting factors are normalized, and at the lowest level, all items are equally weighted. The lowest items are equally weighted not because they are considered equal but because unequal weighting at the lowest level would not result in a significant difference in score when multiplied by the string of higher level weighting factors.

Physical (.1) (E)*
- Electrical (.3)
  - Power
  - Power Switching
  - Grounding
  - Signal Returns
  - Circuit Continuity
  - 1553B Databus
- Mechanical (.7)
  - Weight
  - Size and Location
  - Color
  - Sealing/Int. Atmosphere
  - Mount Seal
  - Rotational Seal
  - Internal Pressure
  - External pressure
  - Heat Transfer

Performance (.3) (E)
- Sighting (.4)
  - Line of Sight Excursion
  - Optical Reference
  - Line of Sight Plumb
  - LOS Synchronization
  - System FOV Alignment
  - Alignment Retention
  - Mechanical Gyro Cross Coupling
  - LOS Position Signal

- Signal Zero Retention
- Sight Drift
- Tracking Rates
- Stabilization Accuracy

Imaging (.6)

- System Field Of View
- Saturation Protection
- Spectral Sensitivity
- Geometric Distortion
- Video Output
- OPT./Thermal Resolution
- MTF
- MRT Difference
- Dynamic Range
- Spurious Signals
- Signal Transfer Function
- Detector/Video Cross Coupling
- Missing Lines
- Image Tilt

Survivability (.3)

Security (.2) (E)

- Acoustical Signature
- Visible/Infrared Signature
- Radar Cross Section

CCM (.2)

- Optical Hardening (E)
- Optical Chem Protection
- Nuclear Hardening--All of 3.3.8

Reliability (.2)

- Endurance
- Service Life
- Storage LIfe
- Lens Fog Condensation
- Ballistic Protection
- NBC Contamination--All of 3.3.9

Mil Stds (.2)

- All of 3.3.1 through 3.3.5

Environmental (.2)

- All of 3.2.5

Operational (.1) (E)

- Sys Readiness
- Cooldown Time
- Stabilization Time
- Time to Switch FOV
- Controls--All of 3.2.1.29
- Indicators--All of 3.2.1.30

Maintainability (.1)
Maint/Diagnostics/Test--All of 3.2.4

Human Factors (.1)
Safety-- All of 3.3.6
Human Performance/Human Engineering (E)

*The letter (E) indicates an area ERIM is qualified to evaluate.

Weight Distribution Rationale and Discussion

Physical

Although the physical characteristics are essential to the success of the system, it is assumed that the system meets the basic physical characteristics; otherwise, it would have been rejected in the first round of the evaluation. Mechanical is rated more highly since it is viewed to be more immutable. Exceeding the requirement can offer improved system performance. The tank chassis has a limited volume and the engine limited power. Reducing the size, weight and power of the CITV can translate into opportunities to increase functionality and overall tank performance and hence merit consideration.

Performance Capability

Performance is likely to have the most variability and is critical to the utility of the CITV. A system that does not perform in spite of meeting all the other requirements should be unacceptable. Improvements in sighting and imaging enable the commander to more effectively complement the gunner and, in fact, may allow the CITV to outperform the GPS. Although the CITV imaging capability may initially be limited by the CID, it is foreseeable that ATR and ATC technology may be capable of overcoming these display limitations. Higher performance gives room for growth. Also there is considerable room for improvement in the dynamic performance.

Survivability

As with performance, this is an area where there can be considerable variability. Likewise, if the system does not operate properly, it has the same effect as a system which does not perform. In terms of its primary purpose, discussed earlier, once

the CITV meets specifications the characteristic of most value to the military is how long will it survive (Security and CCM) and how does it perform under adverse battlefield conditions. Higher reliability cuts costs in two ways: more operating time and less repair work. The Mil Stds and Environmental Tests represent the limits which one can reasonably expect the system to meet. Exceeding these limits is impractical except in a few isolated cases.

Operational

The system must have some essential features; precisely how these are implemented may not be critical. Any significant additions must be reviewed carefully. Additional controls could have the detrimental effect of creating operator overload and must be considered carefully. On the other hand, automatic functions reduce this workload and can enhance performance by eliminating human error.

Maintainability

Maintainability will be a cost driver but should not affect significantly the field effectiveness of the system once the essential requirements are met. A maintainable system reduces the number of spares and increases operational time. Field fixes can significantly reduce the amount of field support and increase the mobility and range of operation.

Human Factors

Human factors should not be ignored but are not seen to represent a major risk. An understanding of the problem should be evident. Once the system meets the required usability and safety levels, little advantage to the Army will result from additional improvements.

TECHNICAL MATURITY EVALUATION

Technical maturity is the essential element in assessing schedule risk. It is also one of the more difficult factors to evaluate as individual companies often have unique processes and/or materials which may be mature within that particular company but unknown to the majority of DOD customers. On the other hand, companies may overstate their experience and confidence in a new process/material. Additionally, new processes/materials may be the

reason for enhanced system performance; however, careful weighting of performance and maturity factors should keep this apparent dilemma in perspective. Evaluators in this area must be strongly supported by instructions to bidders to provide detailed descriptions of processes/materials and experience with the processes/materials for techniques not well known to the DOD.

We suggest items evaluated in this category be grouped by major component and weighted equally as listed:

Optics
Scanner
Focal Planes
Electronics
Scan Conversion (if applicable)
Packaging
Materials

Example of Technical Maturity Scoring Guidelines

Evaluators would follow the same procedure identified under the performance scoring guidelines.

Rating	Definition
0	New product and process; process not demonstrated
1	New product with experimentally demonstrated new processes
2	New product with well demonstrated new process
3	New product; commercial processes needing rework to meet DOD standards
4	New product; commercial processes readily adaptable to DOD standards, or existing product using commercial processes needing rework to meet DOD standards.
5	Existing product using commercial processes readily adaptable to DOD standards
6	New product using DOD standard processes
7	Item or comparable item in commercial production with processes readily adaptable to DOD standards
8	Item or comparable item in production for DOD

PROCEDURAL RECOMMENDATIONS

The following recommendations are procedural in nature to help avoid the enmity of disgruntled bidders and to maximize the effectiveness of the evaluation process:

a) Part of the evaluation procedure should allow for some interaction with the bidders solely through official avenues. This interaction would allow for clarification or in some cases rectification of certain elements of the proposed technical effort. In this way, ample opportunity would be available for any of the bidders to provide sufficiently precise information as to ensure that their proposal is properly evaluated. As one element of this interaction, we strongly recommend that a list of the **unweighted** evaluation criteria be furnished to the CITV supplier as part of the RFP. It seems reasonable that the bidder be given an opportunity to address all of these criteria, and this information should have the added advantage of inspiring an organization's response which reflects the major areas and sub-areas.

b) As part of the evaluation process, we recommend that a minimum of two technically qualified individuals review each of the representative areas and that an informal review be held to identify any large discrepancies in their respective evaluations. This review should not be used as an opportunity to sanitize the responses but to insure major deficiencies and enhancements are realized by each evaluator and to assist in documenting the process in preparation for any potential protest.

c) A modeling effort may be not only desirable but necessary for a complete and informed evaluation of some of the technical specifications provided by the CITV bidders. Modeling can be used as a check to ensure that the proposed performance is self-consistent with technical specifications. Discrepancies could be resolved through a question and answer format channeled officially through contract personnel. To this end, each bidder should provide data which can be used with the CNVEO Static Performance Model for Thermal Imaging Systems to calculate performance. This information should be categorized as "measured" or "theoretical" and any assumptions should be clearly identified. A list of the required data items can be found in the user's manual which accompanies the model.

EXAMPLE SCORING

Following is an illustrative example of establishing the final scores using the suggested scoring guidelines:

CATEGORY (e.g., Subsystem Performance)

MAJOR HEADING (e.g., Physical, Performance, etc.) (weight)

SUBDIVISION (e.g., Electrical, Mechanical, etc.) (weight)

ITEM (e.g.)	SCORE
Power	1 - 10
Power switching	"
Grounding	"
.	.
.	.
.	.

Score calculation:

Subdivision weighted score = (subdivision weight) x (sum of item scores) / (total maximum possible score)

Major Heading weighted score = (heading weight) x (sum of subdivision weighted scores)

Category score = (points allowed for category) x (sum of major heading weighted scores)

The entire technical section could be normalized to the maximum point level, to have the greatest possible impact on total score, by

Technical Score = (maximum points allowable) x (bidder's score) / (highest bidder's score)

ERIM

July 20, 1988

MEMORANDUM FOR THE RECORD

FROM: W. Cesarotti

SUBJECT: 20 July 88, Meeting with R. Kern on Source Selection Evaluation Criteria for the CITV

The subject meeting was held at GDLS at the request of R. Kern to provide guidance on Task 2, Develop Evaluation Criteria, of the CITV proposal preparation services purchase order. A short review of work accomplished to date was concluded with the submission of ERIM comments on the ICD, and GDLS technical personnel stating that the formal ERIM comments on the CITV and Display specification, forwarded through the contracts division, had not been received. A copy of the comments will be hand carried to the next working session which is scheduled for 21 July to support ambient light measurements. GDLS provided the current editions of the CITV specification (5 July 88) and the ICD (1 July 88).

GDLS personnel provided a brief overview of the source selection evaluation plan and requested ERIM recommendations for evaluation criteria on subsystem performance and subsystem maturity areas (both areas are subsets of the technical section of the evaluation plan). ERIM was tasked to take an independent course of action in generating evaluation criteria and provide recommended criteria by the week of 25 July.

GDLS discussed the need for support on evaluating the producibility area of the technical section. ERIM personnel explained that ERIM is not recognized in this area and could not provide peer acknowledged expert support in this area; however, because of recent personal experience of an ERIM employee, ERIM took the initiative to investigate possible sources of Government support. Additionally, ERIM agreed to provide evaluation support on hardening techniques if provisions were made for ERIM to have access to classified information.

Administrative discussions focused on the need for a DD 254 to provide ERIM access to classified data, and GDLS stated desire to have ERIM support the CITV evaluation. NOTE: ERIM support of the source selection is not provided for in the current agreement.

ERIM

July 22, 1988

MEMORANDUM FOR THE RECORD

FROM: R. Watts

SUBJECT: 21 July Working Session at GDLS

The morning was devoted to making measurements on ambient lighting at and near the Commander's Independent Display (CID) in the Abrams tank. The results and recommendations of the test are documented in the memorandum titled "Ambient Light Measurements. Highlight results are: 1) the ambient conditions with the hatches closed are significantly lower than thought, and 2) it is possible for direct sunlight to fall on the display via the vision blocks. It was felt that this latter item would require further study, and a request for further information regarding the geometrical relationships between the vision blocks, viewer, and display was requested. Both Sabha Meir and Neil Hahka were contacted regarding this request. I felt that I could do a rough calculation that would probably be within twenty percent of the actual. However, the results were borderline and twenty percent could throw a decision either way as to how to deal with the full sunlight condition since it was not likely to occur for appreciable times during the day and only with less than 50% probability, particularly in areas where cloud cover is common.

An afternoon visit was made to another GDLS building with Rick Mousseau for two reasons: 1) to attempt to find drawings of the IWCS which contained the information needed for a more precise analysis of the full sunlight condition, and 2) to confirm the function of the GPS control called Sensitivity discussed in earlier documents. It was noted that the M1A1 spec used the term IR level to refer to the brightness control function. Referring to item 1, the desired drawings were not available. Concerning item 2, the GPS could not be operated at this time. Mark Buchele/GDLS did say that the sensitivity control worked like the brightness control on a display.

One possible fix for the direct sunlight condition, which was discussed, is to install flaps on the vision blocks which can be closed to eliminate direct sunlight. This has the added advantage of eliminating the nighttime signature resulting from the use of a direct view display.

ERIM

July 26, 1988

MEMORANDUM FOR THE RECORD

FROM: R. Watts

SUBJECT: 26 July Working Meeting at GDLS

Draft copies of the Ambient Light Measurements Document with the Analysis and Recommendations and an outline of the Evaluation Criteria Document were distributed to GDLS personnel. A meeting was arranged to discuss both documents after lunch and included R. Kern, N. Hahka, S. Meir, R. Mousseau of GDLS and R. Watts of ERIM. One copy of the Segment Specification and the BIA Management Plan were returned to R. Kern. The second copy of the Segment Specification was locked in C. Due's office and will be returned after his return from vacation (August 1).

S. Meir raised a concern about the RS-330 specification--in effect, whether it would be inadequate to meet the Horizontal Resolution requirement. The specification states only that the horizontal resolution must be greater than 600 lines with no upper limit. I told him that RS-330 does not restrict the horizontal resolution and that it was possible to find displays which have higher resolution in the horizontal than in the vertical.

R. Mousseau presented a question a Hughes employee had asked concerning whether the Recognition and Identification performance numbers should use the conservative or optimistic requirements. Rick had made some calculations earlier on the GPS system which indicated that the performance was better than the "B" spec curve. I suggested that he use his GPS calculations in conjunction with the geometric information to figure out what kind of resolution on the "B" spec curve would be needed to meet the required performance and how this translates to the computed GPS MRT curve. A decision to use the conservative number will be easier to defend, particularly if an optimistic prediction from the GPS curve is significantly better than a pessimistic prediction given by the "B" spec curve.

The results of the ambient measurements were discussed. It was decided that three actions were to be taken:

1) The CID RFP would be changed to reflect the real ambient light conditions and the full sunlight requirements would be listed as desirable.

2) A memo would be directed to the proper channels to alert the customer and GDLS management that there may be a problem with nighttime security as a result of the direct view display and that the most direct solution may be to include flaps on the vision blocks.

3) More precise measurements of the lighting geometry will be made on the tank mock-up for inclusion as a data item in the CID RFP with the idea that the display manufacturer may be able to use this information to simplify the display design. This will take place Thursday, 28 July.

The evaluation criteria outline was also discussed with R. Kern. We discussed their concept of how the proposal evaluations would be conducted and what measures would be taken to avoid problems which could turn up after the award. Briefly, uniformity of evaluation would be ensured by having at least two people review and grade each section of the proposal using the same scoresheet. They would be very interested in any ideas we might have to help this occur. Also they would very much like to avoid any procedure which might result in the purchase of a technically unacceptable system. I mentioned that we would have more flexibility in this regard if we knew more about how the costs were evaluated. Bob said he would try to find out what their criteria are for evaluating costs.

ERIM

August 2, 1988

MEMORANDUM FOR THE RECORD

FROM: R. Watts

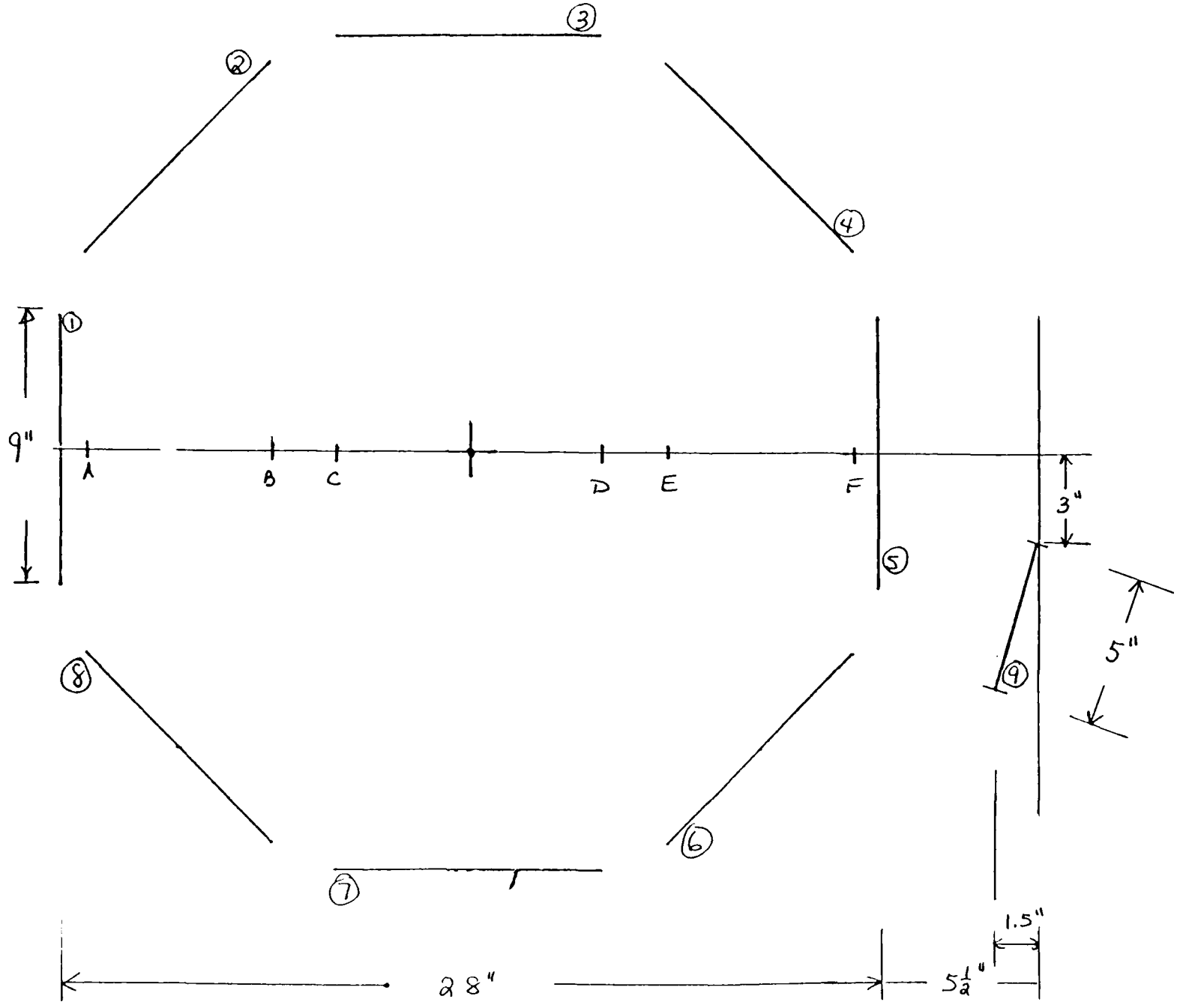
SUBJECT: 28 July Working Session at GDLS

Additional measurements were made to more precisely define the conditions under which direct sunlight will fall on the display as directed in the memorandum of 26 July 1988. These measurements were made on a tank mock-up with a mock-up of the display in place. The ICWS was installed as part of the tank mock-up. The measurements were made with the assistance of R. Mousseau and N. Hahka and are represented in the accompanying drawing. Of particular note was that the typical daytime position of the commander (looking out the vision blocks) is such that his helmet will prevent sunlight from entering from the rear vision block and falling on the display. A simple demonstration was performed to verify this conclusion.

A CCT was provided to GDLS for copying the Night Vision Model which is presently running on the GDLS VAX. This computer program may be used during evaluation of the proposals or for future support of other GDLS efforts.

In discussing further plans to assist GDLS with R. Kern, I told him that we would not be done until next week because of vacation schedules. He made the statement that there was no real rush to complete the evaluation criteria since the proposals were going to go out as drafts again for additional criticism and that we could send over the results next week. If the status changes suddenly, he will get back in touch with us.

TOP VIEW - ICWS 2 DISPLAY



Surfaces ①-⑧ are 2"x 9" Vision blocks

surface ⑨ is the display 5"x 3.5"

SIDE VIEW - ICWS & DISPLAY

Surfaces ①-⑧ are 3" x 9" vision blocks

Surface ⑨ is a 3.5" x 5" display.