AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		7

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0002	30 AUG 2002	56-9225-02	

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
CONTRACTING OFFICER NAVAL RESEARCH LABORATORY 4555 OVERLOOK AVENUE SW WASHINGTON, DC 20375-5326 ATTN: CODE 3230.JW	N00173		

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*	(X)	9A. AMENDMENT OF SOLICITATION NO.
TO BE DETERMINED	X	N00173-02-R-JW04 9B. DATED *(SEE ITEM 11)* 12 AUG 2002
		10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED *(SEE ITEM 11)*

CODE	FACILITY CODE

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a)By completing items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
(Signature of person authorized to sign)		*(Signature of Contracting Officer)*	

The solicitation is amended as follows:

Wide Aspect MWIR Arrays/STATEMENT OF WORK, as set forth in the original RFP:

Paragraph 1.5 Scene Backgrounds, Table 1, as set forth in the original RFP is deleted and replaced by the following Table 1:

Table 1: Photo current and Well Capacity Integration Times. The spectral bands are blue = 3.75-4.15˚ m, red = 4.6-4.8˚ m and polarized red = 4.5-4.8 m. (Half the black body radiation is used for the polarizer band to represent the flux loading in the central region of the filed of view. It will be more nearly full black body at the edges of the FOV.)

Spectral Band	M Elect / mSec			mSec for 8 M Elect		
	blue	red	pol red	blue	red	pol red
30 degF=272K	.18	.37	2.6	44	22	31
100 degF=310.9K	.95	1.5	1.1	8.4	5.3	7.7
130F~100F+aerosol solar	1.7	2.5	1.8	4.7	3.2	4.5

F-no = 2.0, e_{cs} = 80 %, e_{det} = 75 %, $T_{Lens} = T_{Bkgd}$

Paragraph 2.2 Dewar Configuration: F2.4 is deleted and replaced with F2.0 .

Paragraph 3.11: delete 2, 4, or 8 and substitute up to 32

Paragraph 3.13 Performance Summary:

The three lines:

spectral band 3.7-4.9 m detector responsiveness
3.8-4.8 m for cooled filter
3.8-4.2 m & 4.6-4.8 m for uncooled filters

are deleted and replaced with:

spectral band detector quantum efficiency high past 4.8 m
double peaked internal cooled filter passing
3.75-4.15 m and 4.5-4.8 m

The two lines:

dewar design F2.4 cold shield at 80 mm
3.8-4.8 m internal cooled filter

are deleted and replaced with:

dewar design F2.0 cold shield at 80 mm

The two lines:

filter wheel 3.8-4.2 vs. 4.6-4.8 just in front of dewar window
calibration wheel two-point TE, one-point defocus and open

are deleted and replaced with:

filter wheel	control and status for three-position filter wheel in optics
calibration wheel	control and status for three-position wheel in optics with control and status of TE for two-point NUC, one-point NUC with defocus element position and normal operations when in open position.

Throughout the statement of work: substitute 3.75-4.15 instead of 3.8-4.2 for the blue spectral band and substitute the F-number F2.0 for F2.4.

Font flaws in producing symbols throughout the statement of work: we have noticed ten flaws/omissions that occurred apparently due to lack of capability to produce certain symbols in the final publication software; we believe there are no other such flaws. The ten flaws are as follows:

Location		Current symbol	Replace current symbol with:
Page	Description		
2	Formula (1a) - Unclear /4	Unclear	Pi
2	Formula (1a) - denominator inside square root	Unclear	e's and t should all be at the same level as the fraction line of the pi/4
2	Formula (3) between 1.8 and F	letter l	Greek letter lambda
2	Formula (3) between 1.8 l F and 8.46	Blank space	Approximation symbol (double tilde)
3	Formula (6) [space]/4	Blank space	Pi
8	Sect 3.8, spaces before 5%, before .1% and before 0.05%	Blank spaces	Less than or equal to
9	Array dimensions — beginning of spec	Blank space	Approximation symbol (double tilde)
9	Blooming & cross talk - beginning of spec	Blank space	Less than or equal sign

9	Electronic noise — middle of spec	Blank space	Approximation symbol (double tilde)
9	Raw nonuniformity — beginning of spec	Blank space	Less than or equal sign
9	2 point NUC — before .1% and before 0.05%	Blank spaces	Two less than or equal signs
9	Detector averaging — space before 2	No symbol	Square root sign

ATTACHMENT (2), QUESTIONS AND ANSWERS: Add the following questions and answers:

Question 16: Which organizations are the funding sponsors for this development?˚ Has funding been secured and committed for the entire 18 month program?˚ If not, how much funding has been secured and what are the hurdles for obtaining the remainder?

Answer 16: DAS is one of about thirty Technology Demonstration Programs.˚ These are not yearly funded research programs.˚ Rather, they are five year plans focusing on performance and fleet-transition.˚ Each FNC effort must have a formally signed agreement between the initial sponsor who pays for it and a specific platform sponsor who agrees that if performance goals are met that sponsor will then fund transition of the demonstrated equipment to fleet hardware.˚ DAS is currently in its first year and is rated well above the potential funding cut line among FNC programs.˚ DAS funding has been released for FY02 and FY03 and budgeted through FY06 on the basis, however, of a verbal rather than the required written agreement with its intended transition platform sponsor, DDX.˚ Signing of a written agreement for transition has had to await award of the Navy's contract for DDX.

Question 17; What is the definition of "local" non-uniformity after correction?

Answer 17; A 50x50 detector area.

Question 18: Are we the "master" or the "slave" for defining the system frame time?˚

Answer 18: The FPA clock and timing signals such as frame rate are always "master" electronically.

Question 19: What is "salvable" regarding frame rate?

Answer 19: The operator, whether human or computer, must be able to set parameters

like frame rate and especially integration time as the scene flux loading conditions vary.˚ This is not what one would normally call "slave" in the electronic sense.˚ Performance of off-chip summation and the timing of signals to control the calibration wheel and the piezoelectric driver must be slaved to the frame timing signals and controlled by the FPA electronics.

Question 20: What is the cold shield aperture geometry?˚

Answer 20: The F-number of the optics has achieved F2.0 rather the originally estimated F2.4.˚ So Sections 2.2 and 3.13 and Table 1 must be updated accordingly.˚ The entry in the performance summary table of Section 3.13 must now be changed to read:
"dewar design F2.0 cold shield at 80 mm "
This means that the cold shield is to be located approximately 80 mm above the surface of the array and is to limit the thermal radiant loading to any detector of the array to an F-cone of F2.˚ And the cooled spectral bandpass filter is to be placed at this location.˚ See Q&A 22.
˚

Question 21: 100 msec integration time and 10Me- well capacity appear to be inconsistent requirements at the background levels you specify. Do we need to operate with a 100msec integration time without saturating at the minimum background level you specified?

Answer 21: Yes, there is a problem. As indicated in Table 1, well filling will normally occur after an integration time somewhere between 5 and 50 mSec (for sky background and much faster in ocean solar glint).˚˚˚ And this is to be contrasted with Section 1.6 which describes why, for sensitivity, it is desirable to have effective integration times as long as 100 mSec.˚ Section 3.11 goes on to stipulate that the array electronics must be capable of digital off-chip summation of up to 32 sequential frames.˚ In the final application the output of these large arrays must be relayed by Government electronics first through gimbals and then some 150' to 200' to a remote processor.˚ Gigabit eithernet would be convenient for this, so the objective of off-chip summation is to maintain high effective duty cycle while keeping the effective output frame rate in the range of 10-20 after-summation frames per sec.
˚ Note that in Sections 3.11 and 3.12 the off-chip summation is required to be incorporated into several modes of array use and readout.˚ There have been no questions asking for clarification of these readout modes, but here is an example to make sure the requirements are clear.˚ In very cold backgrounds, for instance, Table 1 indicates that off-chip summation of two sequential blue frames would be needed to avoid saturation but still achieve high duty cycle with 10 after-summation frames/sec.˚ But the array Contractor is to provide two ways to perform this summation and bad pixel correction, either with or without an elevation shift of one pixel.˚ And another mode of required readout is with no summation at 20 frames/sec with synchronization provided for the piezoelectric driver so

as to achieve elevation super-resolution.˚ In warm or hot backgrounds these same readout options are to include higher levels of off-chip summation and even the option for both detector averaging and super-resolution.
˚ Part of the reason for these complicated specifications for off-chip summation, integration time, well capacity, dynamic range, residual NUC spatial noise and LOS dithering for detector averaging has to do with Government perception industry capability.˚ The intent of the specifications is to ask for the most that can be achieved given the limitations of today's FPA readouts.˚ Advanced array procurements are expensive, and there are at least two branches of Government that wonder why industry does not use sigma-delta A/D.˚ The principle predates digital.˚ It is now used with great success in virtually all digital audio applications.˚ And it has been demonstrated in silicon unit cells for focal plane array readouts.˚ Expectation is that dynamic range could be 18-20 bits meaning greatly reduced limitations from well saturation, noise and low-flux charge injection efficiency,˚ and perhaps most importantly that linearity could be nearly perfect meaning significantly reduced residual spatial noise after two-point NUC.˚ There is a penalty of increased number of readouts coming off the chip, but they would be low-noise digital.˚ Is thermal load of these lines too much a limitation for a large array?˚ Is there a wait for patents to run out?˚ It would be greatly appreciated if proposals would explain why by now the buyer cannot ask for performance commensurate with sigma-delta A/D.
˚

Question 22: Is˚NRL counting on a Narcissus effect with the warm filters to reduce the background outside of the filter pass band - i.e., is NRL assuming that the warm filters are reflecting the cold FPA (Narcissus) outside the warm filter pass band?

Answer 22: Not significantly for spectral band pass.˚ Our field of view is far too wide. The assumption has been that the cooled filter provided by the array Contractor will be of the dual-peak type, that is, that thermal radiation will be blocked both beyond 4.8 m and between 4.15 and 4.5 m, the dual bandpass peaks being nominally 3.75-4.15 m and 4.5-4.8 m.˚ With this arrangement the uncooled external filters may be simple rather than sharp band edge filters.˚ (The sensor is to be used for viewing paths 8 km and longer, so the long wavelength cutoffs of the atmospheric windows are at 4.8 m and at 4.15 m for the red and blue bands.˚ Exact positioning of the 3.75 m band edge does not matter very much, but the position and shape of the 4.8 m band edge and the removal of the opaque CO_2 region are significant for limiting thermal noise loading.)˚
˚ The uncooled filters have now been included within the mechanical structure for the optics, so the array Contractor is no longer required to supply them and that entry of Section 3.13 has been removed.˚ The array Contractor is, however, still required to control both the spectral and calibration filter wheels and to include status information about them in the digital video header.˚ The filters will be mounted with their dielectric coating side facing the dewar, so yes, there will be some Narcissus effect in the center of the field of view.˚ But they will not be mounted flush against the dewar window and will not block all stray radiation or reflection.
˚ The array Contractor may propose use of a simpler single-peak 3.17-4.8 m cooled filter

in the dewar and rely on Narcissus of the uncooled filters, but only if he then also takes full responsibility and can fully justify performance across the entire field of view for uncooled bandpass filters that have sharp band edges, block stray radiation and are complemented with good baffling within the dewar.
˚ The Narcissus effect, however, is assumed to apply for the center of the field of view for the polarizing filter.˚ This filter will be mounted on the far side of the uncooled 4.5-4.8 m band edge filter away from the dewar.˚ It consists of thin, closely spaced lines of reflective metal deposition on a transitive substrate.˚ These metalization lines should not only block scene radiation but should also not emit from their back side into the dewar.˚ That is why the entries in Table 1 for the 4.5-4.8 red band with polarizer are one half the black body values for this bandwidth.

Black body photon flux values (in 10^{14} Phot/SecCm^{2}Ster) used for recalculating Table 1:˚˚

Blue	Red	Polarized Red	
3.75-4.15 m	4.60-4.80 m	.5 of 4.50-4.80 m	
1.584	3.262	4.542	30F=272K
8.362	13.31	18.78	100F=310.9K
1.512	21.95	31.13	130F~100F + max aerosol solar

Then these flux values times 1.14×10^{-9} (for F2, ecs=.8 & qe=.75) gives millions of electrons per mSec in (25 m)^2:

Question 23: Regarding the sensor packaging and FPA Dewar / Cooler Packaging.˚ Is the customer looking for a compact high reliability custom package design & construction that would be suitable for a fielded system?˚ Or is the desire for a less expensive less custom package that would be suitable for demonstrations?

Answer 23: The first requirement for packaging concerns EMI as stated in Section 2.10.˚ Size, weight and MTBF are discussed in Section 2.7, but here is a fuller appraisal of need.˚ All three arrays with optics will be mounted in stabilization pedestals and first lab and then field-tested.˚ The final performance demonstrations are at present planned to be limited to only land-based detection of aircraft and drones, but requirements and funding for at-sea testing against sea skimming missiles is anticipated.˚ It will be possible to perform repairs in preparation for and often during these tests and demonstrations, but the record of MTBF will be appraised by the transition sponsor.˚ So to some extent this procurement needs more than it can afford to pay for.˚ Yes, compactness and high reliability are needed, but $3M would break the available budget.˚

Question 24: Table 1 contains the term "eeff", which does not seem to be defined.

Answer 24: This is a typographical error. The symbol should be e_{det} meaning quantum efficiency of the detector including fill factor. The other efficiency symbol, e_{cs}, denotes cold shield efficiency.

Question 25: Section 3.8 contains a local uniformity requirement. Please define "Local Uniformity"

Answer 25: This is referring to local residual spatial nonuniformity. This is the rms detector output average over any 50x50 detector area, after two-point nonuniformity correction for which wells are nearly full and not counting temporal noise, in response to a uniform scene at a temperature midway between the two calibration references of the two-point NUC.

Question 26: Section 3.11 requires off chip summation. What do you want reported from this process:
the raw sum of the frames
the average (sum divided by number of frames)

Answer 26: Average slightly preferred, but not if it means loosing significant bits. (It is a bit shift for powers of two summation.)

Question 27: Section 2.9 includes the statement "The contractor must provide an interface to the Government network electronics". This seems to leave a lot open to interpretation:
Does this mean an internet interface?
Eithernet?
A simple interface to a frame grabber?
What type of interface does the NRL have or intend to procure? When does the NRL plan to issue an interface control drawing and an interface requirements document? This could effect the proposed PDR milestone.

Answer 27: The term "Government network electronics" is meant to refer to what happens with the signals after they are received from the focal plane array Contractor, that is, how Government runs signals through the gimbals and down the mast to the below-decks central processor. The quoted phrase could be restated as "The contractor must provide an interface to the Government electronics." In other words you tell us how you want to output and receive signals, and we will take it from there.

All other terms, conditions and provisions remain the same.