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Some Field Observations on OSI Aerial Photography Scales

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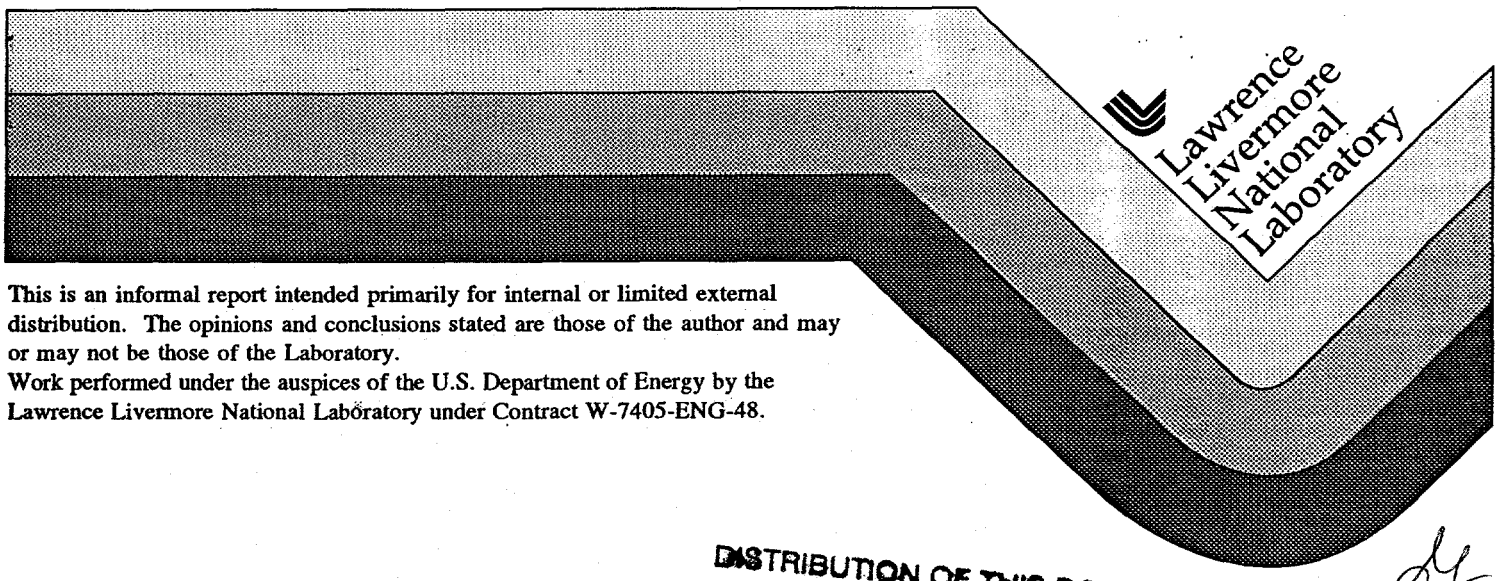
March 16, 1981



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TAC 000/015 H. Heckrotte

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SOME FIELD OBSERVATIONS ON OSI AERIAL PHOTOGRAPHY SCALES

R. Geil

March 16, 1981

(S) The U.S., U.K. and U.S.S.R. are attempting to negotiate a Comprehensive Test Ban Treaty (CTBT) in Geneva. One of the verification procedures presently proposed provides for the possibility of conducting an On-Site Inspection (OSI) if a violation is suspected. According to the terms of the draft treaty, the OSI team would be provided with either (1) stereoscopic aerial photographs with a scale of 1:2,500, or equivalent topographic maps (U.S. version) or (2) a large scale aerial photograph (U.S.S.R. version).

(U) In order to gain a better understanding of the aerial photograph issue, EG&G was asked to take stereoscopic aerial photographs of two areas at the NTS at four different scales, 1:2,500, 1:5,000, 1:10,000 and 1:25,000. The purpose of this paper is to present some field observations on the use for OSI type purposes of these different scale photos. The reader is also referred to a paper by W. Heckrotte, BY 80-16, "Aerial Stereo Photographs for Use in an OSI."

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(S) There are, as far as I can foresee, four possible uses for aerial photography during an OSI:

1. to assist the designated personnel to find their way around the inspection area.

2. to assist the designated personnel in recording the locations where field data are taken.

3. to assist the team leaders in planning and recording the activities of the designated personnel.

4. to assist geologists/geophysicists in explanation of possible anomalous field data.

(U) To assess these four possible uses, two distinctly different areas were chosen at NTS. The first area, near Desert Rock Airstrip, was relatively flat with only small desert bushes and shrubs. The second area, a stretch of Ranier Mesa, featured broken terrain covered predominantly by Pinon Pine trees.

(S) My opinion is that any of the scales under discussion would be adequate for uses 3 and 4, thus, I will address my comments to uses 1 and 2. I assume that contact prints of high quality and size 23 cm x 23 cm are provided to the OSI team. It has been suggested that the treaty should really address resolution of the photographic negative instead of the photo scale. EG&G has produced 20x enlargements of a portion of the photos without resolution or graininess becoming a problem. Since the largest optical magnification usable in the field is probably about 5x, resolution should not be a problem if we assume good faith on the part of the host country and with high quality contact prints being agreed upon. If a host country desires to deliberately impede an OSI, there are many, many ways it can be done that are beyond the ability of a treaty to control.

(S) All four scales were used to test navigational abilities on the flat terrain near Desert Rock Airstrip. Results were generally the same for the first three scales 1:2,500, 1:5,000 and 1:10,000. Although, the larger the scale, the easier it was; it was possible to identify specific terrain and vegetation features on all 3 scales in a reasonable time. It was thus possible to identify specific sites on the ground and on the photos. There seemed to be a breakpoint when using the next scale, 1:25,000, however. It was no longer possible to identify specific vegetation. Only larger terrain features such as washes or gullies could be correlated between the ground and photo. The desert shrubs and bushes ranged from .1 to 1 metre in height and width and were spaced about 2 metres apart. Thus, on the three largest scales it was possible to correlate positions to within 1 metre. On the smallest scale, 1:25,000, the correlation uncertainty depended on the distance from major terrain features such as washes and could be as poor as 10 to 20 metres or more. Walt Morgan spent 1/2 day in similar use of these photos and came to the same conclusion, thus implying that they are not dependent on the observer.

(S) All four scales were also used to test navigational abilities on Ranier Mesa. The only difference was that with the larger vegetation size (Pinon trees ~4 metres wide), it was possible to correlate individual trees even on the smallest scale (1:25,000) thus decreasing the uncertainty to only 3 or 4 metres. The 1:25,000 scale was, however, significantly more difficult to use than the larger scales.

(U) Five different optical aids were tried in field use of the photos. In order of increasing usefulness they were:

1. A B&L reading glass (~2x).
2. An Optivisor (~2x), binocular magnifying lenses worn on a headband.
3. A B&L Measuring Magnifier or eyeloop (~3x).
4. A magnifying lens (~4x) made from a camera lens mounted on a small stand.
5. A stereoscopic viewer (~3x) consisting of 2 lenses on a wire frame stand.

(S) The stereoscopic viewer was very useful in the field on Ranier Mesa, but was of almost no use at all on the flat terrain near Desert Rock. We should definitely hold out for stereoscopic aerial photos in the Geneva negotiations, since they would be extremely useful in broken or uneven terrain. Our present position offers the option of providing topographic maps in lieu of the stereoscopic aerial photos. My experience in using both topo maps and aerial photos is that it is far easier to find your way using photos as opposed to topo maps of the same scale. I, therefore, recommend we delete the topographic option from our negotiating position (also, since it is our suggestion, and the Soviet position does not include it).

(S) My overall recommendation on the appropriate scale for the aerial photos is either 1:5,000 or 1:10,000. While our present scale negotiating position of 1:2,500 is easier to use at a particular spot, the large number of photos required (~100 for a 10 km^2 area) is excessive and would be a burden itself. The detail on 1:2,500 is not really needed and either 1:5,000 or 1:10,000 would be quite useful. For a 10 km^2 area, 1:5,000 would require ~25 stereo photos and 1:10,000 would require ~10 stereo photos. The 1:25,000 scale called for in the PNET is smaller than desirable in some situations and difficult to use in the field. The difference in scale between the PNET case and a CTB-OSI situation can be defended on the basis of the difference in the operations to be carried out.

RG:jm

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