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18 AUG 1967

MEMORANDUM FOR CAPTAIN GOOLSBY

SUBJECT: MOL Generalized Target Model

The attached copy of the SAC final report on the MOL Target Model is for your information and retention.

C. L. BATTLE
Colonel, USAF
SAFSLM

1 Attachment
a/s

RUFF

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FINAL REPORT
FILE Y
PROJECT GOODFELLOW

Lt Col Goodfellow and Major Jewell, AFNICAD, initially briefed the SAC Director of Intelligence, B/G Stewart, on the necessity of building a target model base in support of a high resolution reconnaissance system having an intelligence requirement orientation the week of 23 January 1967.

General Stewart tasked the 544th ARTW with the model construction; project personnel were selected and briefed by Lt Col Goodfellow and Major Jewell during the same week. This model base would have a maximum photographic resolution of [redacted] and a maximum diameter of nine thousand feet. AFNICAD requested some thirty seven specific intelligence items to be included in the final model data base composed of 585 representative items provided by them.

The original project completion date for Phase One allowed for sixty calendar days, but this was extended seven days to 31 March.

The 544th ARTW Research Center was the focal point of project work with assistance provided from the Data Systems, Trajectory, and Target Materials Centers.

Twenty-three of the forty-two personnel were employed throughout all phases of the model construction and/or data compilation. The others supplied expertise on specifics and/or were concerned with limited aspects of one or another phase as the project progressed.

The initial project planning for Phase One involved two concurrent actions: Structuring of the model file and the identification of the basic list of COMOR numbers.

The project planning and working group was not briefed into the complete project as envisioned by AFNICAD. In some respects this proved to be a handicap, especially in the planning phases, but it also led directly to the remarkable flexibility of the completed model base. The file was structured within the limitations established by the requester. The planners decided that the base had to be structured so as to provide for simple and rapid entry enabling the intelligence analyst to modify, add, or delete information. This structuring requirement dictated extensive programming support and extremely close coordination with the air intelligence analysts. The resulting model flexibility proves the logic and foresight of the requirement.

The structuring of the model base proceeded in a logical sequence. The first step was to determine precisely what elements of information, requirements, and identification were needed. Once these were firmly established the second step was to design a format compatible with electronic data processing equipment. This became the proforma sheet.

Various creation sheets were standardized to input coding instructions, requirements, and data into the base file in accordance with methods and instructions provided by applicable DIA and USAF directives. Each field address was cross referenced with its enabling source document.

AFNICAD supplied this organization with a listing of 585 COMOR numbers. This basic list represented a cross sampling of countries, target data inventory categories, and representative complexes and installations. The sample model was constructed of these.

The first problem was to identify each COMOR number included on the basic list by basic encyclopedia number, name, and TDI category. A complete COMOR listing was not available at this headquarters, therefore a manual search was made of the 585 numbers using the Defense Intelligence Agency priority reconnaissance objectives list (PROL) and other ID. This search netted information on all but forty-six items. The automated intelligence file was queried and provided information on 544 of the basic list numbers. This was an important factor developmentally since it meant that thirteen basic intelligence items could be directly fed by computer into the final reconnaissance model tape. The AIF was further exploited to refine, confirm or flush-out information extracted from other sources.

Actual photography was used in this project in order to select photographic aiming points, provide X and Y coordinates, and diameters for these selected aiming points. The Research Center photographic interpreters established a requirement for high quality of photography.

All standard sources of photographic reference available at this headquarters were researched for coverage: CMER, IPIRS, CMCI, installation dossiers, and the 544th ARTW chip file. Selected photography was reproduced at a scale of 1:75,000 which was a Target Materials Center mensurating requirement. Research Center photographic interpreters selected and pricked 2,434 individual aiming points from 699 separate pieces of photography.

Target Materials Center personnel then provided mensurated and geodetic coordinates on each pricked point with the assistance of the Trajectory Center. The first step in this process was the derivation of geographic coordinates keyed to either a 200 series air target chart, or if no 200 series was available, to the best existing map source. These coordinates were scaled to the nearest thousandth of an inch and computed to the nearest tenth of a second.

The second step was the transformation of the mensurated geographic coordinates to mensurated geodetic coordinates. The mensurated datum, elevation, positional error, geographic latitude and longitude of the reference points were formatted on creation sheets and keypunched for transformation.

The Trajectory Center performed the third step, the translation of these mensurated geographic coordinates into geodetic coordinates. The punch cards were processed against the Vening-Meinsz formula which transformed the European, Tokyo, Indian, and North American datums into the Department of Defense world geodetic system 1960 datum. A magnetic tape with the resultant mensurated geodetic data was then used to correlate this data with the Research Center data retrieval information.

As in any project of this complexity certain problems arose from time to time. Some were foreseen and tentatively reconciled while others were resolved as they were identified.

The initial problem and one which stayed with the project team until the conclusion was the fact that the working project team members were not completely briefed on the utilization of the system or systems which would ultimately be used in conjunction with the expanded file. This caused an uncertainty in fixing the specific parameters of information and requirements to be included in the proforma and creation sheets. This uncertainty also led directly to the decision to make the resultant file base as flexible as possible in both entry and retrieval.

Simple identification of an installation from a given COMOR number posed difficulties inasmuch as no single document or memory core at this headquarters contained all 585 COMOR referenced installations. As pointed out earlier the Automated Intelligence File proved to be the most lucrative source. Despite the use of the AIF binary tape, however, a great deal of the model base file information had to be manually manipulated and hand coded into the proforma and creation sheets. This presented a serious time handicap which was overcome only by people and overtime work.

The photographic problems involved the lack of adequate or acceptable prints necessitating reordering in a search for quality coverage. In some few instances adequate photographic coverage was simply nonexistant.

Another problem encountered was in the determination of X and Y coordinates for KH-4 photography. This was resolved by the design of special X and Y grids by the photographic interpreters for use with the 1:75,000 scale prints. The photographic interpreters also evolved a rationale for calculating the size of the complex diameter required as a piece of input datum for this model base construction.

The most serious problem encountered, however, came with the updating of the AIF binary tape, ICOD March. The original intent was to include a great deal of specific complex and installation data in the new model base directly from the AIF tape. This was keyed to the COMOR number. There were numerous changes made in the March AIF tape. This prevented the original programming proceedures from being followed. A required last minute change in programming was made in order to retrieve the necessary information. As previously mentioned, not all installations were covered by the AIF binary tape. All information relevant to these had to be completely hand coded.

The model file design was structured to operate on the Strategic Air Command's formatted file system (FFS). The FFS is a general purpose information storage and retrieval system used with the IBM 7094 computer, which is currently used by DIA, ACIC, BSD, Goddard Space Center, and the Lawrence Radiation Lab as well as by SAC. The 7094 FFS language and logical operation is also compatible with the DIA IBM 1410 formatted file system.

Phase One, Project Goodfellow's specific file contains fixed fields and two sets of periodic fields. A fixed field is a piece of data which appears only once per logical record or line item. A periodic field is a piece of data which may appear more than once per logical record. Each peice of meaningful data is identified as a field and as such can be used for input, retrieval, processing, and output formatting.

By organizing the data in line items, the user is allowed to manipulate all the information about a geographic location at one time. Also inputs, data changes, retrieval, and output operations can be made on the basis of logical groupings of information or sub-categories.

Data can be introduced into the model file in two formats. The first format is used to combine hand coded and computer generated data into a single line item. The computer generated information includes coordinate conversions and targeting information available from other established sources. The hand coded information is needed for data which must be hand massaged.

The second input format is used to introduce data from line items where no computer generated information is already available. All of the information for this second format must be hand coded. Proforma sheets are used for both input formats.

Information retrieval from the model file is controlled by logical operations on any of the defined fields, geographic area searches on coordinate parameters, changes in field content, matches on data values, and totals on numeric field entries. Further controls are also provided to break the line items into smaller amounts of data and to recombine them into larger amounts. The language used, the possible logical operations, and the FFS retrieval operation are fully documented in the FFS retrieval techniques manual.

The general formats of the four output listings were suggested by Lt Col Goodfellow during his initial briefing to the 544th ARTW. The final formats were determined from an analysis of the probable desired output as well as from a knowledge of desired intelligence products in general. These formats may be easily changed or rearranged simply by changing the control cards in the multiple output packages used to produce the listings. This feature extends the flexibility of the model file use.

Phase Two of Project Goodfellow began with a realistic review of the targets' priorities, and subsequently changing them. The original priorities in the sample model were selected in a more or less random manner. The new priorities were established by arranging the targets into related areas: Offensive, Defensive, Research and Development, Production, Support, and Miscellaneous. Targets within each group were arranged by category in relation to intelligence interest. The significant item within the first three categories was given a single, low number ranging from 1 for SS-10 associated ICBM silos to 64 for CW/BW Research sites. This numbering process was repeated for items of secondary significance within the offensive categories and ran 65 to 81. The remaining items of lesser significance were numbered sequentially within each category beginning again with SS-10 associated ICBM sites but continuing through to include all categories. The lesser items therefore ran from 82

through 502. For example: Category 80030, Arctic Staging Bases, have as their significant item AOB (Air Order of Battle) with a priority of 6, while the item of lesser significance is Airfield Services and Capabilities with a priority of 70. Category 87123, IRBM Launch Sites, Hardened, have as their significant items Launch Silos with a priority of 7 and Nuclear Warhead/Nosecone Handling Facilities as the lesser item with a priority of 71.

Of the original 585 items selected for Phase One of Project Goodfellow, approximately 50 items had no photographic coverage. At the meeting on 13 April 67 it was agreed the RC would select at least 15 new items from the master deck to insure that the Math Model would have a full capability. The final re - selection consisted of 23 items representing 240 targets, bringing the total number of targets within the sample model to 608. The items which were replaced remained in the file to retain realism.

Concurrently with the completion of the Sample Model File, the computer FFS operating system was revised to enable increased capabilities for file maintenance and processing. The new version, Model 8, of the FFS system became available to SAC in May 1967. Model 8 FFS enables over twice the previous amount of information about an installation to be contained in a single logical record. All of this additional data is available to control file manipulation and processing. File maintenance capabilities include the ability to extract and combine data from other FFS files with the data in the Sample Model File. For instance, when new versions of related files are received, the corresponding data in the Sample Model File may be updated automatically.

A request to calculate and tabulate distances between pairs of points necessitated the development of a FORTRAN program, since the distance computation is not within the capabilities of FFS. The FORTRAN program uses a spherical trigonometric formula to compute distances from an input of latitude and longitude coordinates. Note, that the FFS system is capable of a geographical area search, however.

Once the Sample Model File was completed and the change from Model 7 to Model 8 successfully accomplished, the main task of Phase Two was ready to be made, that of expansion. Expansion of the file from the original 608 items, to include 4059 additional items, was done for the purpose of supplying SSD with a Mathematical Model to serve as a realistic data base without involving additional time, equipment, or funds.

AFNICAD supplied the 544th ARTW with a complete listing of items which was converted into a useable format by supplying BE numbers. These, when associated with the COMOR numbers which were already given, permitted usage of the FFS AIF to give name, major and minor reference numbers, category, chart data, coordinates, complex data, elevation, and TDI significance for each item within AIF. Those items without BE numbers (some 230 in number) were put into the file manually, as were the items with BE numbers but without COMOR numbers matching in AIF (approximately 300 items).

A FORTRAN program was developed to expand the Sample Model File. The added items were given the same objective configuration as similar items in the Sample File. That is, the correct mensurated coordinates for an added installation were given, and the DOD World Geodetic System and objective mensurated coordinates were computed so that the numeric relationship of the coordinates were identical to the similar Sample File items's configuration. Futhermore, other data concerning mission coverage, priority, reconnaissance requirements, and target description were made the same in the added items as in the similar Sample File items. Thus, except for the coordinates and photo reference, all Basic Intelligence information supplied is as real as possible.

The Expanded File contains about 9000 logical records, including 4667 items and 13,519 objectives. The file requires 3 reels of magnetic tape for storage in packed binary form. A dump of the file in BCD output would fill an estimated 11 reels of magnetic tape. The size of the Expanded File required a modification to the output capabilities of the Model 8 FFS. The processing of such a large volume of data may require operation on only a portion of the file at one time.

An assessment of the uses of the Math Model, including present planning figures only, reveal numerous possibilities. In addition to a wide variety of file summaries, it is also possible to have the system make mathematical judgements.

Queries can be made to determine all targets with a specific photographic resolution requirement, a specific priority, or a specific objective requirement, either singly or in combinations.

The flexibility of the systems is ideal for flight plans, when the type, location, and number of targets along a flight path are desired to be known. The system allows for the selection of desired targets over any path, for example, all SAM Sites, or all Airfields, or all Fighter Bases.

The system will also prove useful in maintaining currency of history files by providing information on when a target is due for updating - frequency of coverage and the date of the last coverage.

If File Y were to be used in an operational capacity, there are several recommendations for improvement to eliminate excessive maintenance problems:

a) The entire Complex and Installation data is repeated for each different AP priority in the Sortie Planning List. Presently the volume of data contained within the file presents a manipulation problem that will require time and experience to overcome.

b) A difficulty encountered during AP counting was that of double AP's - those single AP's having more than one priority. It is suggested that this be eliminated by placing the second and subsequent AP designators in the second space of the AP column - example: Initial AP Designator = A-; Subsequent AP's = -A.

c) A need was found for a means of standardizing AP Designators within categories by type of objectives. That is, all missile silos within ICBM Sites should be A's, all control buildings B, all ramps C, etc. Within the category for Fighter Bases, all parking aprons should be A's, all hangars B, ect.

Other recommendations include providing for a system for deriving complex information and placing an installation within a complex, standardizing diameters to allow a comparative diameter listing to be made, providing full, operational requirements, i.e. camera data, and finally assuring a proper file currency through updating tapes supplied to all users.

The overall use and value of File Y will be extremely limited if aspect angles, object resolutions, times of day and other technical information are not included for each target. (See FTD msg TCS 450976/67).

Further, the file should be revaluated from the standpoint of the practicality of search targets, suspect targets, and even some TDI categories.