File Solid Waste

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 14 1980

5/17

MEMORANDUM FOR: Bernard J. Snyder, Director
TMI Program Office

FROM: Robert E. Browning, Deputy Director
Division of Waste Management

SUBJECT: MEETING WITH DOE REGARDING TMI-2 CLEANUP WASTE DISPOSAL

Attached for your information is the description of alternatives for disposal of wastes resulting from operation of EPICOR-2 and the SDS system which was discussed during the meeting with DOE representatives on May 13, 1980. The NRC representatives at the meeting were R. Browning and H. Lowenberg. The DOE representatives were G. Oertel, H. Feinroth, J. D'Ambrosia and A. Millunzi.

DOE is now reviewing the alternatives, determining whether other alternatives should be added from their standpoint, and developing pros and cons for each alternative. We will be doing the same thing from our standpoint and will meet with DOE again on May 16 at 2:00 p.m., to finalize the alternatives which will be pursued by DOE. DOE representatives indicated particular interest in doing some research and development work on an accelerated basis which would: (1) resolve the concern with regard to radiation stability of the EPICOR-2 organic resins; (2) confirm the capability of removing the Cesium from the EPICOR-2 organic resins and transferring it to inorganic resins such as SDS first stage units; and (3) identify possible ways of solidifying such inorganic resins into forms capable of meeting high-level waste criteria for storage or disposal purposes. However, the DOE representatives continue to stress their role as research and development assistance and not as a repository for commercial high-level wastes at this time and did not express confidence that they would ever be able to accept all of the Cesium-loaded inorganic resins for processing in a DOE facility as high-level waste even if NRC were to make such a judgement. Further, they emphasized their concern that the NRC EIS on TMI-2 wastes should cover generic alternative disposal schemes, but should not be specific on geographic locations, since they feel that mention of specific sites would affect DOE programs in a very negative manner.

Robert E. Browning
Robert E. Browning, Deputy Director
Division of Waste Management

Enclosure: as stated

cc w/encl:
J. B. Martin
J. G. Davis

DRAFT
HLowenberg
5/13/80

Alternatives for Handling Submerged Demineralizer System Wastes

Met. Edison is currently planning to process the waste water in the containment sump (CS) and the reactor coolant system (RCS) by using a submerged demineralizer system (SDS). This system will collect wastes on prefilters, final filters, first stage inorganic ion exchangers, second stage organic cation exchangers and third stage polishing organic ion exchangers. At this time the amount and composition of the material that will be retained on the two filters is conjectural and it is difficult to postulate the disposal of these units until more is known. However, they should be able to be handled along with either the spent fuel first or later stage ion exchangers.

First Stage Ion Exchangers

The bulk of the 550,000 curies of radioactivity in the CS and RCS water is from Cs-134 and 137 and is planned to be captured on the first stage ion exchangers. These units will contain about 7 ft^3 of zeolite material which will be in 2 ft diameter by 4 ft high stainless steel containers (liners). When loaded with radionuclides, each liner will retain about 10,000 curies. The licensee has assumed that the first and second stage SDS wastes will be solidified and sent to commercial shallow land burial sites. Accordingly, the first and second stage liners are of similar stainless steel design and contain sacrificial mixers for solidification. However, based on the projected specific activity of 1500 Ci/ft^3 for first stage liners and the total inventory of over 1/2 million curies of Cs-137 (half-life >30 years), the first stage SDS units are more like high-level wastes than low-level wastes and do not appear to be suitable for commercial burial ground disposal. Thus the provision for solidification appropriate for shallow land burial (cement) appears to be a useless and costly item which will be of no

value. In fact, solidification of these materials in cement or other currently available low-level waste systems (i.e., cement, bitumen, polyester, etc.) seems undesirable and counter-productive to subsequent conversion to an appropriate high-level waste form as noted below. All of the alternatives discussed below would include shipment of the wastes off-site in Type B licensed shipping casks.

1. Solidification on site by Met. Edison with cement, etc., and shipment to commercial burial grounds. The solidification step in this case with zeolites should be quite practical from physical and chemical standpoints and will not require a development program. However, demonstration of solidification in the SDS liner and radiation stability of cements in the anticipated radiation fields will be necessary and a facility similar, less complex, but more heavily shielded than for the Epicor-2 liner solidification will be required. However, disposal of these units in commercial facilities either solified or in high integrity containers seems highly unlikely as noted above. From a commercial standpoint, the loaded first stage SDS liners could be retained in a TMI or AFR spent fuel pool or sent to NFS West Valley for combination with wastes there. In any of these cases solidification would inappropriately foreclose future waste form treatment and thus be undesirable. In the event that none of these commercial options appear appropriate, there appear to be several alternatives involving DOE handling of these wastes with appropriate Met. Edison payment for services as noted below.
2. Shipment of dewatered resins to DOE facilities for further processing, storage and disposal.
   a. Shipment to ORNL for elution of Cs-137 and manufacture of irradiation sources--disposal of slightly contaminated waste resins.

b. Shipment to Hanford 300 Area for vitrification in NVP facility and storage or use in DOE programs with ultimate disposal in a Federal repository.

c. Shipment to the Hanford 200 Area for transferral to waste tanks or Cs isolation programs.

d. Shipment to the Savannah River Plant for transferral to waste tanks or Cs isolation programs.

Second and Third Stage Liners

At this time it is not clear what the radionuclide inventory on these units will be. However, it appears these units may have activity levels similar to the Epicor-2 second and third stage units and thus should be able to be handled similarly.

Alternatives for Handling Epicor-2 Wastes

First Stage Wastes - Prefilters

Epicor-2 first stage wastes are mixtures of organic and inorganic ion-exchange media containing 4.3-43 Ci/ft^3 of radioactivity, principally Cs-137. At the present time, NRC does not have information on the composition of the ion-exchange media, but this data has been requested from the licensee. These wastes are contained in 4-feet diameter x 4-feet high coated carbon steel containers (liners). These liners do not have the mixing capability required for resin solidification and are presently being loaded and/or temporarily stored at the TMI-2 site. Recovery plans by Met. Edison indicate that a total of about 100 such liners will be generated during the recovery operation through 1984. About 45-50 liners containing about 35,000 curies resulting from the cleanup of the auxiliary building which is under way will comprise the initial batch of this waste and will contain most of the radioactivity. The present Commission order requires solidification before shipment. The liners and contents can be shipped off-site in licensed Type B shipping casks.

Disposal Alternatives

1. Disposal at commercial burial brounds
   a. Met. Edison is presently initiating a solidification development and demonstration program to be able to comply with the Commission order with regard to solidification. Assuming successful completion of the program, Met. Edison will have to design and construct a facility on-site for sluicing the resins from the present liners into liners with mixing capability and for carrying out the solidification operations. This will take 1 1/2 to 2 years or more by the licensee's plans and increase the projected volume of 3000 ft^3 to 5000 ft^3. Thus, under Met. Edison's present planning, some time in 1982 it may be possible to ship these

wastes off site to commercial burial grounds depending on the limitations imposed by regulations and such sites at that time.

In lieu of the solidification technique, repackage the liners or contents in high integrity containers for shipment to and disposal at commercial burial grounds. At this time the specifications for such containers are not established, but a life time of several hundreds of years for the containers seems likely. This would require design and procurement of containers with a facility for their use and sealing at the site. Probably about a similar time interval (1 1/2 - 2 years) would be involved as for alternative a. However, this concept would require less on-site handling than a. above.

c. Despite the Commission order on solidification, the licensee appears to feel that this provision is unwarranted and believes that shipment as dewatered resin to licensed burial grounds is satisfactory. If judged feasible, shipment in the present liners could be initiated in the near future. If disposal in this form requires high integrity containers, alternative b. above covers the disposal.

d. Any of the above alternatives might be combined with other special disposal techniques such as deeper disposal, mine shaft disposal, special site considerations, etc. However, such techniques would require the development of criteria and resultant facilities in addition to present commercial burial grounds or projected Federal repositories and would be quite time consuming and do not have much prospect for speeding up the operations or providing significant improvement in the health and safety aspects, or in achieving early public acceptance.

2. Changing the form of the wastes by Met. Edison and handling of the wastes by other means. The radionuclides might be eluted from the mixture of organic and inorganic materials onto all inorganics (zeolites) and a considerable (about 2 orders of magnitude) volume reduction achieved, plus better long term characteristics. Projection of such an operation at TMI indicates that the bulk of the radioactivity (Cs and Sr) on ~50 liners (1500 ft^3) from the auxiliary building wastes could likely be reduced to about four SDS liners (28 ft^3) with the Epicor-2 liners being reduced in radioactivity suitable for commercial burial ground handling. This might involve additional operations in the Epicor processing building after completion of present auxiliary building cleanup operations. The wastes resulting from such a plan would in all likelihood be judged to be unsuitable for handling at any commercial facility, except for long-term storage at TMI or another reactor or away from reactor spent fuel pool or shipment to the NFS West Valley facility for incorporation in the high-level wastes at that site. However, since such wastes might be considered as equivalent to high-level wastes, there are several alternatives for handling at DOE installations as noted below which would involve Met. Edison payments or credits to the government for services rendered and values received. Each of these alternatives involves shipment of the inorganic resins in a licensed Type B cask to a DOE facility:

   a. Shipment to ORNL for removal of the Cs-137 and its ultimate incorporation into irradiation sources.

   b. Shipment to Hanford 300 Area for vitrification using the nuclear waste vitrification facilities in buildings 324 and 325. Subsequent storage of the vitrified wastes until a Federal repository is available. In the interim the vitrified wastes could be used in the DOE development and demonstration program.

c. Shipment to Hanford 200 Area for combination with other Cs wastes in capsules or in waste tanks.

d. Shipment to Savannah River Plant for combination with other Cs wastes in the high-level waste program.

3. Shipment of the Epicor-2 carbon steel liners containing dewatered resins in licensed Type B casks to DOE facilities for further processing, storage and ultimate disposal.

a. Shipment to ORNL for removal of the CS for manufacture into irradiation sources. Disposal of the remaining slightly contaminated waste resins could follow several routes without apparent difficulty.

b. Shipment to Hanford 300 area for any of several processing routes; elution to inorganics followed by vitrification, or dissolution of organics, followed by spray calcination and vitrification. Interim storage or use of vitrified wastes in demonstration programs could be planned until ultimate disposal.

c. Shipment to the Hanford 200 Area for elution from organics for transferral to waste tanks or incorporation into the Cs isolation program.

d. Shipment to the Savannah River Plant for elution from organics for transferral to waste tanks or incorporation into the Cs isolation program.

Second and Third Stage Wastes - Demineralizers 1 and 2

The second and third stage wastes from the Epicor-2 system consist of greatly diluted concentrations of radionuclides captured on undisclosed mixtures of organic resins contained in coated carbon steel containers (liners) as projected below. At the present time, NRC does not have information on the composition of the ion-exchange media, but this data has been requested from the licensee.

Stage	Size ft dia x ft high	Projected No of Liners, Aux. Bldg. Cleanup	Total	Projected Specific Activity, Ci/ft³
Second	4 x 4	25	30	0.002 - 2
Third	6 x 6	10	21	0.01 - 0.06

Based upon original Met. Edison plans, each type liner with its radionuclide loading was planned to be dewatered and shipped to a licensed shallow land burial site.

The Commission order on the use of the Epicor-2 system required solidification of all of these resins. To carry out this requirement, the development and demonstration program outlined in 1. above for the first stage resins will be required and it will take about 2 years before any shipment offsite can be accomplished. License conditions for the commercial burial ground in the State of Washington, which may be typical for such operations, require stabilization by solidification of all materials after June 30, 1981, that contain radionuclides with half lives greater than five years and contain a specific activity of 1 μCi/cc or greater. For Epicor-2, this translates to 3.11 curies for a 6 x 6 liner with 110 ft^3 or 0.85 curies for a 4 x 4 liner containing 30 ft^3. Based upon the present Epicor-2 data, 5 of the 7 third stage and 1 second stage liner meet this requirement and could be conservatively disposed of in the dewatered condition. It is possible that other Epicor-2 liners could be reduced in radioactivity by the elution process mentioned in 2 above to levels that would meet this stringent criteria; otherwise, solidification or high integrity containers would be required.

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BBS. Done 5/20

Pre- NAS Briefing
Chairman / Dircks / John Davis
Browning / Martin /
Lowenberg / Snyder
5/19 BBS

R. BROWNING -

RECENT NRC ACTIONS TO FOCUS ATTENTION ON TMI-2 CLEANUP AND ASSOCIATED WASTE DISPOSAL.

H. LOWENBERG (W/OERTEL) -

NRC ACTIONS WITH RESPECT TO OFF-SITE DISPOSAL - ALTERNATIVES BEING CONSIDERED.

R. WELLER -

NRC ACTIONS WITH RESPECT TO ON-SITE DISPOSAL AND STORAGE.

TMI-2 WASTE DISPOSAL

RECENT EVENTS TO FOCUS NRC ATTENTION:

FEBRUARY 1980 - SPECIAL TASK FORCE ON THREE MILE ISLAND CLEANUP REPORT

MARCH 1980 - TMI PROGRAM OFFICE ESTABLISHED WITHIN THE OFFICE OF NUCLEAR REACTOR REGULATION

APRIL 1980 - TMI-2 WASTE DISPOSAL SUPPORT GROUP ESTABLISHED WITHIN THE OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

LIMITATIONS

1. LIMITED DISPOSAL SITES AND LITTLE LIKELIHOOD OF ANY NEW ONES IN NEAR FUTURE.

2. PRESENT NRC REGULATIONS DO NOT CONTEMPLATE TMI-2 WASTES AND THUS DO NOT PRECLUDE DISPOSAL BY SHALLOW LAND BURIAL. DRAFT NEW REGULATION (10 CFR 61) WOULD PRECLUDE DISPOSAL OF SOME OF THE TMI-2 WASTES BY SHALLOW LAND BURIAL.

3. PRESENT SHALLOW LAND DISPOSAL SITE LICENSE CONDITIONS DO NOT CONTEMPLATE TMI-2 WASTES AND THUS DO NOT PRECLUDE DISPOSAL BY SHALLOW LAND BURIAL.

CONCLUSION

NEED TO EVALUATE WASTES ON CASE-BY-CASE BASIS AS PROCESSING ALTERNATIVES ARE FIRMED UP AND RESULTING WASTE CHARACTERISTICS BECOME KNOWN. TWO SPECIFIC EXAMPLES:

1. RESINS RESULTING FROM AUXILIARY BUILDING WATER CLEANUP.
2. RESINS RESULTING FROM REACTOR BUILDING WATER CLEANUP.

EXISTING CRITERIA APPLICABLE TO DISPOSAL OF EPICOR-II WASTE

NOVEMBER 1975 — NRC STAFF POSITION THAT FOR REACTOR PLANTS UNDERGOING LICENSING REVIEW AFTER NOVEMBER 1975, SPENT RESINS AND FILTER SLUDGES SHOULD BE COMBINED WITH A SUITABLE BINDING AGENT AND FORMED INTO A SOLID MATRIX.

OCTOBER 1979 — COMMISSION MEMORANDUM AND ORDER DIRECTING LICENSEE TO EXPEDITIOUSLY CONSTRUCT A FACILITY FOR SOLIDIFICATION OF EPICOR-II RESINS.

JANUARY 1980 — WASHINGTON STATE LICENSE CONDITIONS APPLICABLE TO THE HANFORD BURIAL SITE OPERATED BY NECO. (Same for Barnwell; will be accepted at Hanford)

RESINS IN THE DEWATERED FORM CAN BE RECEIVED PROVIDED:

A. UP TO DECEMBER 31, 1980, SUCH RESINS CONTAIN LESS THAN 1% BY VOLUME LIQUID PER CONTAINER;

B. EFFECTIVE JANUARY 1, 1981, SUCH RESINS CONTAIN NO MORE THAN 0.5% BY VOLUME OR ONE GALLON LIQUID, WHICHEVER IS LESS, PER CONTAINER.

} Non-corrosive liquid products of process

C. AFTER JUNE 30, 1981, SUCH RESINS HAVING A TOTAL SPECIFIC ACTIVITY OF 1μ Ci/cc OR GREATER OF MATERIALS WITH HALF-LIVES GREATER THAN 5 YEARS MUST BE STABILIZED BY SOLIDIFICATION.

} no liquid

Also allows high integrity container alternative.

(Hanford would generally consider high integrity containers also but not specifically in their license)

COMPARISONS OF POTENTIAL TMI-2 FIRST STAGE WASTES WITH LLW AND HLW DATA

	LLW-PWR REACTOR EXPERIENCE	EPICOR-2 WASTES (First stage)	REACTOR BLDG. WASTE	HLW CHARACTERISTICS
SPECIFIC ACTIVITY, Ci/FT^3	.1-10 (Avg. 1)	4-40 (Avg. 20)	1500	400-1000[1] 225-250[2]
INVENTORY, Ci	1100[4]	>30,000	550,000	11,000,000[3,4]
SIGNIFICANT RADIONUCLIDES	Co-58 Co-60 Cs-137	Cs-137 Sr-90	Cs-137 Sr-90	Cs-137 Sr-90 Transuranics

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1 IDAHO HLW CALCINES
2 SRP HLW SLUDGES
3 10 CFR 51.20 - TABLE S-3
4 ANNUALLY PER REACTOR

Antimony ?

Need to size 2nd stage demineralizer in SDS so as to remove Na and allow removal of antimony in 3rd stage. Not clear. Must do this

Rick - you should follow up here →

POTENTIAL HANDLING OF EPICOR-2 WASTES

FIRST STAGE

1. DISPOSE OF DEWATERED RESINS BY SHALLOW LAND BURIAL (ORIG. MET-ED PLAN)

2. SOLIDIFY AND DISPOSE IN SHALLOW LAND BURIAL (COMMISSION ORDER)

*3. HIGH INTEGRITY CONTAINER & DISPOSE IN SHALLOW LAND BURIAL (EQUIVALENT TO 2)

*4. CONCENTRATE Cs-137 TO INORGANICS Zeolite (EQUIVALENT TO HLW)
DISPOSE OF REMAINING RESINS SIMILAR TO 2ND OR 3RD STAGE RESINS

5. DOE USE FOR R&D PURPOSES

* POSSIBLE DOE R&D ASSISTANCE

POTENTIAL HANDLING OF REACTOR BUILDING WASTES

FIRST STAGE

1. Solidify and Dispose of as LLW (Met-Ed Proposed Plan)
2. Use High Integrity Container and Dispose of as LLW (Alt. to 1)
3. Store as Dewatered Resin as HLW in Reactor Fuel Pool or AFR.
   *Later Convert to Improved Form and Container for Repository Disposal
4. Use by DOE in Rand D. Programs
   - Byproduct Sources
   - HLW Form Development
   - Others

*Possible DOE R&D Assistance

2nd & 3rd Stages are organic resins - needed to remove other isotopes (other than Cs, Sr) - Have some problem as in Epicor II for solidification.

NAS Presentation for Wed.

Copy to Collins Wed. F.S.

INSTITUTIONAL ISSUES AND CONCERNS
SOLIDIFICATION REQUIREMENTS AND CRITERIA

- NRC BULLETIN OF JANUARY 19, 1980 - RESINS AND FILTERS > 1 μCI/CC AFTER 7/1/81 "MUST BE STABILIZED BY SOLIDIFICATION". "HIGH INTEGRITY CONTAINERS" ARE AN OPTION TO SOLIDIFICATION. NO CRITERIA FOR "HIGH INTEGRITY CONTAINERS".

- THE 10/19/79 NRC ORDER PERMITTING EPICOR-II OPERATION REQUIRES RESIN SOLIDIFICATION. "LICENSEE SHALL EXPEDITIOUSLY CONSTRUCT A FACILITY FOR SOLIDIFICATION OF SPENT RESINS . . . "

- GPU TENTATIVE SELECTION - CONCRETE FOR EPICOR-II. CONCRETE FOR SDS IF SOLIDIFICATION REQUIRED

- NRC (NMSS) COMMENTS 4/11/80
  - SOLIDIFICATION CRITERIA SUBJECT TO CHANGE
  - SHOULD "ENHANCE" LEACHABILITY
  - CONCRETE SOLIDIFICATION OR ORGANIC RESINS WITHOUT "LEACHABILITY ENHANCEMENT" "MAY NOT BE ACCEPTABLE"

INSTITUTIONAL ISSUES AND CONCERNS (CONT.)
ULTIMATE DISPOSAL OF LIQUID

- 10/16/79 NRC ORDER - "DOES NOT AUTHORIZE DISCHARGE INTO THE ENVIRONMENT OF ANY OF THE PROCESSED OR UNPROCESSED WASTE WATER."
- SETTLEMENT AGREEMENT, CITY OF LANCASTER, 2/27/80 - NO DISCHARGE OF ACCIDENT-GENERATED WATER UNTIL 12/31/81 OR COMPLETION OF EIS.
- EPICOR-II EFFLUENT (WHEN DILUTED WITH ISLAND EFFLUENT) COULD BE DISCHARGED AND BE WELL BELOW EPA DRINKING WATER TOLERANCES (EXCEPT FOR ^{3}H)

G. K. HOVEY - 5/20/80

INSTITUTIONAL ISSUES AND CONCERNS (CONT.)

OTHER PENDING MATTERS

- DOT HAS PUBLISHED PROPOSED CHANGES TO 10CFR49 CONCERNING TRANSPORTATION OF RADIOACTIVE MATERIALS "COMPATIBLE WITH LATEST IAEA STANDARDS."

- NRC - PARALLEL CHANGES TO 10CFR72 "PACKAGING OF RADIOACTIVE MATERIAL FOR TRANSPORT AND TRANSPORTATION OF RADIOACTIVE MATERIAL UNDER CERTAIN CONDITIONS."

- COMPREHENSIVE RADIOACTIVE WASTE MANAGEMENT PROGRAM - EXECUTIVE ORDER OF 2/12/80
  - STATE PLANNING COUNCIL
  - WASTE REPOSITORY PLANNING
  - NRC/EPA - CONSULT AND RESOLVE JURISDICTIONAL PROBLEMS
  - DOE LEAD AGENCY - COMPREHENSIVE NATIONAL PLAN "LATER THIS YEAR".

- GAO - MARCH 31, 1980 (EMD 80-68) "THE PROBLEM OF DISPOSING OF LOW-LEVEL NUCLEAR WASTE: WHERE DO WE GO FROM HERE?"
  - NEW LOW-LEVEL WASTE DEFINITION
  - CONCERN EXPRESSED OVER BURYING WASTE "HIGH IN RADIOACTIVITY" IN SHALLOW-LAND BURIAL".
  - GOVERNMENT SHOULD RESOLVE JURISDICTIONAL PROBLEMS AND GET ON WITH THE JOB AT HAND.

INSTITUTIONAL ISSUES AND CONCERNS (CONT.)
WASTE CLASSIFICATION AND DISPOSAL

- HALLER REPORT - "THE METHOD OF PROCESSING THESE (SDS) WASTES MUST NOT PRECLUDE THE OPTION OF PROVIDING THE WASTE TO THE DEPARTMENT OF ENERGY FOR SUBSEQUENT PROCESSING AND DISPOSAL AS HIGH-LEVEL WASTE".

- DRAFT 10CFR61 (SCHEDULED FOR ISSUE IN 1982) "LLW CONTAINING RADIONUCLIDES IN CONCENTRATIONS EXCEEDING THOSE TABULATED . . . (EXAMPLE: $^{137}Cs \leq 1.3$ CI/M^3) ARE GENERALLY NOT ACCEPTABLE FOR DISPOSAL BY SHALLOW LAND BURIAL . . . "
  NOTE: BARRIERS, WASTE FORM, RADIONUCLIDE DISTRIBUTION, SITE-SPECIFIC CONDITIONS MAY BE REASON FOR RELAXATION.

- HALLER REPORT - " . . . THE CONTINUED AVAILABILITY OF THE HANFORD SITE TO LOW-LEVEL RADIOACTIVE WASTES FROM OUTSIDE THE STATE OF WASHINGTON IS TENUOUS.

INSTITUTIONAL ISSUES AND CONCERNS (CONT.)

SOLIDIFICATION REQUIREMENTS AND CRITERIA (CONT.)

- NO NEAR-TERM PLANS TO ISSUE LEACHABILITY OR CONTAINER CRITERIA

- MAY IMPOSE REQUIREMENT OF POLYMER ADDITION TO CONCRETE.
  CAPABILITY MUST IN PLACE BY 7/1/81.