AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

Classification Cancelled and Changed To

DECLASSIFIED

DECLASSIFIED

By Authority of RM Allen

4-4-94 CG-PR-2

By J E Savely 4-17-94

Verified By Jessi Mally 4-18-94

HW-79653

This document consists of 7
pages.

November 13, 1963

1. EV Padgett
2. HE Berg
3. WA Blanton
4. FW Knight
5. WN Mobley
6. JT Stringer
7. JJ Wick
8. 300 Files
9. Record Center

E. V. Padgett, Supervisor
Process Control Engineering
Fuels Engineering Operation

E-N SUPER FUEL ELEMENTS

INTRODUCTION

The current E-N demonstration program began during mid-November 1962 in the ALSi Shop. Many meetings and conferences were held prior to this time to determine various methods by which the ultimate quality of the uranium portion of an E-N load could be enhanced at the expense of the material yield, if necessary. As a result of these meetings, it was decided that a superior grade fuel element could be manufactured by raising or lowering, as the case may be, certain limitations that were currently governing the normal "F" process production. The new limitations were presented in Process Work Request 116 (1962), and the program began with fuel lot KY-312-E on November 19, 1962.

QUALIFICATION

For the purpose of this report, all fuel lots or portions thereof that have been sent to "H" Reactor have been considered as E-N fuels. All other lots have been considered "F" process fuels. Sufficient data was not maintained to positively identify all E-N lots. The best available records were consulted, however, and all statements made in this letter were confirmed, assuming that the "best available data" was factual.

~~the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, or any other law, regulation, or executive order, or any person is prohibited from~~

MASTER

This document classified by

EV Padgett
E. V. Padgett

DECLASSIFIED

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DECLASSIFIEDSUMMARYTotal Bond Count

An analysis of the Quality Certification data from the fuel lots that have been sent to H Reactor since November 19, 1962, indicates that the average internal and external bond count of E-N fuel is greater than normal "F" process fuel by 1.62 and 2.58 counts, respectively.

Ultimate Yield

The over-all yields for E-N and regular O3E fuel elements that have been produced since November 19, 1962 are 82.4 per cent and 85.6 per cent, respectively. This data indicates that the E-N manufacturing limitations imposed by Process Work Request 116 (1962) have caused the rejection of approximately 4,848 fuel elements.

BOND COUNT DATA

During the period from November 19, 1962 through October 31, 1963, a total of 176 O3E fuel lots have been canned. There were 57 lots in this group that had Quality Certification samples, and 20 of the parent lots represented by these samples were sent to H Reactor as E-N fuels.

The following table presents the variables data that was obtained from fuel lots that were shipped to the reactors other than H.

Type of Fuel	Total Qual. Cert. Elements Measured	Sum of External Bond Count	Sum of Internal Bond Count	Average External Bond Count	Average Internal Bond Count
"F" Process	1,093	2,286	8,947	2.09	8.18
E-N Process	638	2,981	6,250	4.67	9.80

It is well to mention that the data presented above does not include four lots, KY-351, GY-019, GY-039, and KY-380, due to the existence of questionable data on the Quality Certification input cards. Lot KY-351 was classed as E-N material, the other three were normal "F" process material.

YIELD DATA

H Reactor has received at least a portion of 61 lots of E-N fuel elements during the past eleven and one-half months. The remaining 115 lots have been shipped to the other "O" size reactors.

The following table presents the raw data by which the production yields for those lots that were shipped to H Reactor (E-N), and "F" process lots (other reactors) were calculated. For information purposes, the standard method and yield calculation is obtained by subtracting the number of elements that are sent to Reprocess Storage from the number canned to obtain the yield base. The number of elements

DECLASSIFIED

E. V. Padgett

-3-

HW-79653

November 13, 1963

sent to storage is then multiplied by 100 and the product is then divided by the yield base to obtain the yield for the lot in question.

RAW DATA

<u>Type of Material</u>	<u>Number Canned</u>	<u>Number to Re-process Storage</u>	<u>Yield Base</u>	<u>Number to Storage</u>
"F" Process	254,212	21,136	233,077	199,525
E-N Process	137,584	8,546	129,038	114,292
Reprocess E-N	8,397	52	8,345	5,819
UT-4 Rejects				

It should be noted that the E-N lot yield cannot be calculated by the standard method. During the production of "F" process material, all UT-4 rejects are classed as a reject and sent to Core Recovery. However, during the production of E-N material, all UT-4 rejects are sent to reprocess storage and the number of these pieces is subtracted from the number canned to obtain the yield base. This procedure then causes the resultant yield to be biased upwards since the material from E-N lots that are sent to reprocess storage actually contain valid rejects that should not be subtracted from the original number canned.

It is in view of these considerations that the yield for the E-N lots was calculated in the following manner, and that for "F" process material was calculated in the standard manner to obtain a figure of 85.6 per cent.

Original number canned	137,584
+ Number of UT-4 elements in three reprocess lots	8,397
<u>Adjusted Number Canned</u>	<u>145,981</u>
Original number to reprocess storage	8,546
- Number of UT-4 elements	<u>8,397</u>
	149
+ Number of UT-4 elements sent back to reprocess	52
<u>Adjusted Number to Reprocess Storage</u>	<u>201</u>
Adjusted number canned	145,981
- <u>Adjusted R.P.S.</u>	<u>201</u>
<u>Adjusted Base</u>	<u>145,780</u>

DECLASSIFIED

E. V. Padgett

-4-

HW-79653
November 13, 1963

Original number to storage	114,292
+ Reprocess UT-4 to storage	5,819
Adjusted to Storage	120,111
Adjusted E-N = $\frac{120,111}{145,780} \times 100 = 82.4$ per cent	
Yield	145,780

For clarification purposes, a summary of all yield calculations is given below.

<u>Process</u>	<u>Means of Calculating</u>	<u>Numbers</u>	<u>Yield</u>
F	Standard	$\frac{199,525}{233,077}$	85.6
E-N	Standard	$\frac{114,292}{129,038}$	88.6
F	First Run	$\frac{199,525}{254,212}$	78.5
E-N	First Run	$\frac{114,292}{137,584}$	83.1
E-N	Adjusted	$\frac{120,111}{145,780}$	82.4
E-N+F	First Run	$\frac{313,817}{391,796}$	80.1
All O3E	Standard	$\frac{319,636}{370,460}$	86.3
E-N Reprocess	Standard	$\frac{5,819}{8,345}$	69.7
All O3E Adjusted	Standard	$\frac{325,455}{387,202}$	84.0

YIELD DISCUSSION

It was stated in PWR 116 (1962) that the minimum acceptable yield for E-N elements would be 50 per cent. Assuming that the presented methods of calculating "F" and E-N lot yields is correct, the E-N lot yield was considerably better than that set as a minimum. It is of interest, however, that when the "first run" yields of the two groups are compared, it is seen that the E-N yield is greater by 4.6 per cent.

DECLASSIFIED

E. V. Padgett

-5-

HW-79653
November 13, 1963

This fact means that, even though the ultrasonic testers were set to reject fuel elements at a tighter reject setting for E-N material, more pieces of this material passed the testers, at a higher bond count, than from normal tested "F" process lots. It is possible to propose many reasons for this phenomena, however, a valid explanation is not known.

The average O3E yield for the material in question from November 19, 1962 to the present time as reported by Process Control and Materials Sub-Sections is 86.3 per cent. When the fact is taken into consideration that true UT-4 rejects were sold into reprocess storage from E-N lots and subtracted from the number canned, it is found that the true over-all yield on this material is 84.0 per cent. This indicates that the O3E yield that will be reported for essentially all of CY 1963 is biased to the high side by 2.3 per cent.

E-N PRODUCTION HISTORY

The first two months of E-N production were quite troublesome to say the least. The internal bond quality was very poor, and it was not at all uncommon to have defective rates in excess of 2.0 per cent. This problem was resolved on January 18, 1963, when it was discovered that if the annulus of the core was not filled with AlSi prior to preheating in the lead layer of the duplex furnace, a fractured internal bond layer was a certainty. It was eventually determined how to provide agitation during submerge and the internal bond problem associated with E-N fuel was eliminated. During the preceding E-N canning run, however, approximately 1,000 fuel elements were rejected to Recovery as internal bond rejects at an average defective rate of 2.1 per cent.

The already excessive AlSi slop defective rate was aggravated by the E-N canning condition that required a minimum temperature of 586 C. The average CPR-0 (AlSi slop) defective rate during the first E-N canning run was 15.8 per cent as compared to 2.3 per cent for previous non E-N six-inch fuel. It was at this time that knurled cans were first used on a production basis. The knurling was successful from the standpoint that it reduced a 15.8 per cent AlSi slop defective rate down to 3.7 per cent defective. On December 6, 1962, Diversey PX-1288 was applied to the AlSi groove region of the cans for the first time and this process essentially eliminated the AlSi slop defective rate. However, the E-N canning temperature requirement had been responsible for at least 1,021 fuel elements being rejected during the previous 12-day E-N run as AlSi slops.

The production and subsequent testing of fuel elements manufactured under E-N conditions required that the UT-4 braze integrity testers be set to reject at 18 total bad discs and/or 12 consecutive bad discs as compared to 22-18 normal "F" process fuels. All of the UT-4 rejects from E-N lots were saved and sent to reprocess storage for future testing under "F" process reject limits. To date, three lots (8,397 elements) of UT-4 rejects have been retested by the AlSi Shop, usually on a Saturday.

During the course of the investigation into the disposition of the fuels that had been manufactured to provide a superior fuel for H Reactor, it was discovered that a portion of one retested UT-4 reject lot had been sent to H Reactor for use as E-N fuel.

DECLASSIFIED

E. V. Padgett

-6-

HW-79653
November 13, 1963

The following table gives the disposition of the three UT-4 reject lots that have been shipped as of this date.

<u>Lot Number</u>	<u>Number to Storage</u>	<u>Number to H</u>	<u>Number to Other</u>
SY-020-J	2,696	0	2,696
SY-031-J	3,353	353	3,000
SY-037-J	1,104	0	1,104

This is to say that the only thing that H Reactor received with regard to super fuel was an element that had been canned at elevated duplex and canning temperatures, welded at a reduced R.P.M., and then weld inspected under five power magnification at Weld Inspection.

It was also found that H Reactor received material from recovered core lots that had not been tested through the UT-2 testers under the existing tester limitations. Some of the recovered core lots may well have contained cores that had been accepted at a small grain voltage of 0.3 volts as opposed to the then existent 0.9 volts. It was also found that mixed metal and oil quench lots were used at H Reactor as E-N fuel.

The most recent E-N canning run (Y-19) was unsuccessful due to an external thin wall problem. It was quite evident that the minimum canning temperature requirement of 586 C was simply too hot to produce an element with a can wall that would pass the penetration testers. There were 20 lots scheduled for this E-N run, however, only 16 lots were ultimately classed as E-N fuel due to the high thin wall defective rate or the the planned reduction of canning temperatures below the required E-N conditions such that a reasonable lot yield (86+ per cent) could be maintained.

The recent work by Process Control into the method by which the minimum canning temperature for E-N metal should be established should prove to be the solution to the thin wall problem. The fact remains that during the Y-19 canning run, approximately 3.3 per cent of the E-N fuel elements that were manufactured were rejected to Recovery as external thin wall rejects due to canning conditions as opposed to a non E-N average defective rate of 0.4 per cent.

The last limitation that was imposed on E-N fuels was the 40-hour autoclave requirement for those lots that exhibited a pinhole defective rate in excess of 0.5 per cent. The existing pinhole problem began on November 14, 1963, or five days before the start of E-N production, and, unfortunately, continues to this writing. Needless to say, numerous E-N lots were autoclaved for 40 hours due to the existence of excessive pinholes. A test was conducted that disproved the necessity of this extended time and the requirements were reduced to the nominal twenty-hour exposure. It should be noted that the three autoclave ruptures that have been experienced since November 19, 1962 have not been due to the minor pinholes as exhibited by either normal production or E-N material. It should also be noted that upon three occasions, fuel elements were palletized prior to autoclaving due to the lack of autoclave baskets as a result of the E-N production limitations. It, of course, follows that the marred surface defective rate at Final Inspection was higher than normal due to

DECLASSIFIED

E. V. Padgett

HW-79653
November 13, 1963

the added handling operation involved with these elements. The actual figures are available to confirm the foregoing statement; however, they were not calculated.

RECOMMENDATIONS

It is recommended that the following list of facts about E-N fuel be given the fullest consideration to evaluate first the quality and secondly the economics involved to produce any future E-N fuel elements under the limitations imposed by PWR 116 (1962) and/or its supplements.

1. The external bond count of an E-N element is greater than "F" process fuel by a factor of 2.2.
2. The internal bond count of an E-N element is greater than "F" process fuel by a factor of 1.2.
3. The average yield of E-N lots as compared to "F" process lots has been 3.2 per cent less during the past twelve months.
4. Some of the E-N UT-4 reject material was retested under normal "F" process conditions and used at H Reactor as E-N fuels, the same elements that were not suitable as E-N fuel when they were contained in the parent lot.
5. It was discovered that many of the scheduled E-N lots have been shipped to other reactors and, needless to say, this practice is a waste of effort on the part of both Manufacturing and Process Control. If it is decided to continue with the E-N process, serious planning should be exercised such that only the absolute minimum amount of O3E - E-N fuels are produced.
6. An effective data system by which identification of all E-N lots can be determined should be developed, designed, and maintained by Process Control. At the present time, it is impossible to determine exactly which O3E lots were considered to be E-N fuels other than through the fact that some lots were scheduled as E-N and by the fact that certain lots were shipped to H Reactor.

Engineer, Product Engineering
Fuels Engineering Operation

JJ Wick:skc

DATE

FILMED

8/4/94

END