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August 23, 1984

TO: M. J. PLODINEC

FROM: W. N. RANKIN

REPAINTING DECONTAMINATED CANYON CRANES

INTRODUCTION AND SUMMARY

The paint on the H-area hot canyon crane is expected to be at least partially removed during the planned decontamination with high pressure Freon® blasting. Tests to evaluate two candidate finishes, Dupont Imron® polyurethane enamel and Dupont Colar®

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epoxy were carried out at Quadrex Co., Oak Ridge, TN, March 1984. Three types of 304L stainless steel surface finishes were included in the test (ASTM#1, bead blasted ASTM#1, and ASTM#2B). Two types of contamination were used (diluted dissolver solution, the type of contamination encountered in existing canyons; and raw sludge plus volatiles, the type of contamination expected in DWPF). Some specimens were coated with the type of grease (Mystic JT-6) used on cranes in SRP separations areas.

The results of the test indicate that smoother surfaces are easier to decontaminate than rougher surfaces. Statistical analysis of the data from this experiment by R. L. Postles (Attachment 1) leads to the following conclusions:

- There is no statistical difference between the decontamination properties of Du Pont Imron® polyurethane enamel and Du Pont Colar® epoxy.
- Du Pont Imron® polyurethane enamel and perhaps Type 304L stainless steel with an ASTM#2B surface finish are easier to decontaminate than Type 304L stainless steel with an ASTM#1 surface finish.
- Dilute dissolver solution is harder to remove than raw sludge plus volatiles.
- Specimens with grease are easier to decontaminate than specimens with no grease.
- Freon® blasting pressure has no statistically significant effect.

Based on these results, Du Pont Imron® polyurethane enamel is as easily decontaminated as the present epoxy coating. However, because the required curing time is half that of the present finish, we recommend Imron® as the top coat for repainting the decontaminated H-area hot-canyon crane.

<u>TEST VARIABLES</u> (Table 1)

<u>Surface Evaluated</u>

Two candidate finishes were evaluated. Du Pont Colar® epoxy is the topcoat presently recommended by Du Pont Engineering Dept. for surfaces exposed to chemical and radiation environments (SP-124). This finish requires 7 days for complete curing before it is put into service.

J. C. Courtright, Staff Chemist, Marshall Laboratory, Du Pont F&FP Dept., recommended Du Pont Imron® polyurethane enamel as an attractive alternative topcoat. This finish has similar resistance to chemicals and radiation as the epoxy. In addition, it has a smoother surface finish, which should trap less contamination. In addition, an Imron painted surface can be placed in service in 3-4 days, half the time needed for Colar.

The appearance of these surfaces at 500X on the Scanning Electron Microscope is shown in Figure 1. The results of surface finish measurements are given in Table 2.

- Du Pont Imron® polyurethane enamel

  The surface of this finish is very smith (10 microinches). There are only a few sites for entrapment of contamination.

- Du Pont Colar® epoxy

  The surface of this finish is also fairly smoth (32 micro-inches). However, some sites for entrapment of contamination can be seen.

Type 304L stainless steel with a range of surface finishes was also evaluated.

- ASTM#2B (hot rolled, pickled, and cold rolled)

  This is the surface presently specified for the inside of hoods at SRP. It has a smooth surface finish (9 microinches). However, many sites for contamination entrapment exist.

- ASTM#1 (hot rolled and pickled)

  This is the standard mill finish on Type 304L stainless steel. It is much rougher than an ASTM#2B surface finish (161 vs. 9 microinches). Many large, deep areas exist on an ASTM#1 surface finish for contamination entrapment.

- Bead Blasted ASTM#1

  Bead blasting is an inexpensive technique for producing a somewhat smoother surface finish (144 vs. 161 microinches). However, it does little to eliminate the large, deep areas where contamination can become entrapped.

Contamination

Two types of contamination encountered by cranes at SRP were used. Dilute dissolver solution is the type of contamination that exists in present separations areas. Raw sludge plus volatile material from the waste glass melter is the type of contamination expected in the DWPF.

Grease

Some specimens were coated with grease after they were contaminated. This was done to simulate lubricated areas of the crane. Mystic JT-6 is the type of grease presently used on cranes in SRP separation areas.

Pressure

Two pressures were used for Freon® blasting, 500 and 3800 psi. These pressures represent a low pressure and the highest pressure available on the equipment.

EXPERIMENTAL PROCEDURE

All specimens were 1" X 3" coupons. They were contaminated at SRL by placing 0.05 ml of contaminant in the center of the face of each specimen. Specimens were allowed to dry in air at room temperature after they were contaminated. Specimens were monitored individually to determine the amount of contamination applied.

Tests were carried out at Quadrex Co., Oak Ridge, TN using a Quadrex Tool Decon unit. Freon® blasting parameters (Table 3) were selected so that the specimens would only be partially decontaminated. The same blasting conditions were used for each specimen. Cleaned specimens were returned to SRL and indivudally monitored to determine the amount of radioactivity remaining. The percent reduction in total radioactivity was used as the measure of the retention of contamination.

RESULTS

Changes in total activity on the specimens are given in Table 4. The average change in activity for each surface evaluated is plotted vs. the surface finish in Figure 2. This plot indicates that smoother surfaces are easier to decontaminate than rougher surfaces.

CONCLUSIONS

The data was analyzed using statistical techniques by R. L. Postles (Attachment 1). Major results are:

- Decontaminability of Du Pont Colar® epoxy and Du pont Imron® polurethane enamel are similar (63.6 vs. 72.3%) removed. The differences between these finishes are not large enough to be declared real, based solely on data from this experiment. However, their ordering is consistent with the idea that the ease of decontamination increases with surface roughness. This is clearly supported by Figure 2. A polyurethane enamel topcoat would therefore be expected to be easier to decontaminate because only a few sites for entrapment of contamination exist. Another advantage of a polyurethane topcoat. Equipment can therefore be returned to service in a shorter time.

- Du Pont Imron® polyurethane enamel and perhaps type 304L stainless steel with an ASTM#2B surface finish are easier to decontaminate than Type 304L stainless steel with an ASTM#1 surface finish (72.3 and 69.3 vs. 49.3% removed). The chemical resistance of Type 304L stainless steel is well known. The data indicate there is no adverse intereaction between the polyurethane coating and the contaminants used.

- Dilute dissolver solution is harder to remove than raw sludge plus volatiles (34.4 vs. 87.9% removed). This would be expected because the dissolver solution is acidic while raw sludge plus volatiles is more alkaline.

- Specimens with grease are easier to decontaminate than specimens with no grease (67.5 vs. 54.8% removed).

- Freon® blasting pressure has no statistically significant effect. Preliminary tests[1] indicated that better decontamination may have been achieved with higher pressure. However, not enough data was obtained for a statistically meaningful conclusion. The data from the present test indicate that low pressure Freon® blasting decontaminates just as well as high pressure blasting. This is encouraging for applications where high pressure blasting would not be desirable such as inside old HB-line glove boxes.

RECOMMENDATION

Based on the result of these tests Du Pont Imron® polyurethane enamel is recommended as the topcoat for repainting the decontaminated H-area hot-canyon crane.

QUALITY ASSURANCE

This work was performed in accordance with the QA review for radioactive testing of decontamination techniques.[2] Data are recorded in DPSTN-4203.

WNR:tlw

Att

REFERENCES

1. RANKIN, W. N., "Evaluation of High Pressure Freon® Decontamination - I Preliminary Tests," DPST-83-939, October 31, 1983.

2. RANKIN, W. N., "Quality Assurance Review, Radioactive Testing of DWPF Decontamination Techniques," DPST-QA-83-2-11, February 9, 1983.

TABLE 1

TEST VARIABLES

Surface

- o Du Pont Imron® polyurethane enamel
- o Du Pont Colar® epoxy
- o Type 304L stainless steel
  - ASTM#2B
    (Hot rolled, pickled, and cold rolled)
  - Bead Blasted ASTM#1 Surface Finish
    (hot rolled, pickled, and bead blasted)
  - ASTM#1 Surface Finish
    (hot rolled and pickled)

Contamination

- o DWPF-type
  (raw sludge plus volatiles from plenum of HLC melter)
- o SEP-type
  (dilute dissolver solution)

Grease (Mystic JT-6)

- o Yes
- o No

Pressure (psi)

- o 500
- o 3800

TABLE 2

SURFACE FINISH MEASUREMENTS

Surface	Surface Finish* (microinches)
Polyurethane	10
Epoxy	32
Type 304L Stainless Steel	
- ASTM#2B	9
- Bead Blasted ASTM#1	144
- ASTM#1	161

* Average of 6 measurements

TABLE 3

FREON® BLASTING PARAMETERS

Distance (in)	Angle (degrees)	Time (sec)	Flow (GPM)
6	45	15	4.5

Table 4
CHANGE IN ACTIVITY

Surface	Contamination (Type)	Pressure (psi)	Grease	% Reduction	(Duplicated)	Average % Reduction
DuPont	DWPF	500	yes	88.9	(88.9)	
Imron®			no	90		
polyurethane		3800	yes	100		
enamel			no	100	(100)	72.3
topcoat	SEP	500	yes	50	(83)	
			no	16.7		
		3800	yes	100		
			no	16.7	(33.3)	
DuPont	DWPF	500	yes	75	(80)	
Corlar®			no	75		
epoxy		3800	yes	90		
topcoat			no	89.5	(88.9)	63.6
	SEP	500	yes	57.1	(66.7)	
			no	33.3		
		3800	yes	57.1		
			no	33.3	(16.7)	
ASTM	DWPF	500	yes	85	(86.4)	
#2B			no	95		
304L ss		3800	yes	95.5		
			no	95	(96)	69.3
	SEP	500	yes	42.9	(83.3)	
			no	42.9		
		3800	yes	28.6		
			no	14.7	(66.7)	
Bead Blasted	DWPF	500	yes	78.3	(85.7)	
ASTM			no	81.8		
#1		3800	yes	83.3		
304L ss			no	83.3	(88.5)	51.3
	SEP	500	yes	0	(85.7)	
			no	0		
		3800	yes	14.3		
			no	0	(14.3)	
ASTM	DWPF	500	yes	80	(86.7)	
#1			no	92		
304L ss		3800	yes	91.7		
			no	92.3	(75)	49.3
	SEP	500	yes	28.6	(16.7)	
			no	0		
		3800	yes	14.3		
			no	14.3	(0)	

Figure 1

APPEARANCE OF SURFACES TESTED

PAINTED SURFACES

DU PONT IMRON® POLYURETHANE ENAMEL
(surface finish 18 microns)

DU PONT COLAR® EPOXY
(surface finish 32 microns)

TYPE 304L SS SURFACES

ASTM #2B
(hot rolled, pickled, and [illegible])
(surface finish 9 microns)

Bead Blasted ASTM #1
(hot rolled, pickled, and bead blasted)
(surface finish 144 microns)

ASTM #1
(hot rolled and pickled)
(surface finish 161 microns)

|———|
2 mils

cc: W.R. Stevens
J.W. Wade
R.B. Ferguson
F.D. Knight
M.J. Plodinec

May 10, 1984

TO: [redacted]

FROM: R.L. POSTLES Dick Postles

RE: EVALUATION OF DECONTAMINATION OF SURFACES PAINTED WITH POLYURETHANE : ANALYSIS OF DESIGNED EXPERIMENT

You wanted to study the effects of 4 variables on a property measuring the ease with which radioactive waste can be removed from metal. The 4 variables are:

Variable	Levels
Type of Finish (or BASE)	BASE1: #1 Stainless BASE2: #1BB Stainless BASE3: #2B Stainless BASE4: Epoxy-painted BASE5: Polyurethane-painted
Type of Contamination (or CONT)	CONT1: DWPF CONT2: Separations
Pressure (or PRESS)	PRESS1: 500 psi PRESS2: 3800 psi
Grease	GREASE1: Yes GREASE2: No

The dependent property is the % Reduction in Initial Radioactivity effected after a fixed cleaning procedure.

Since all of the variables except PRESS are categorical, there was no economy possible in the experimental design. Hence, all combinations possible were executed. Within the 2**3 factorial for each BASE, 4 combinations were duplicated to give an estimate of irreproducibility.

The resulting data were treated by Analysis-of-Variance (fixed effects model) using SAS PROC GLM. The major results are:

i. The polyurethane finish is easier to decontaminate than the #1 finish. (That is, the observed difference in average level is enough larger than the irreproducibility in the data to discern that difference as real.)

ii. There are indications that the #2B finish is also easier to decontaminate than #1, although this depends on which statistical test is used.

iii. Otherwise, the observed differences between finishes are not large enough to be declared real, based solely on this data. However, their ordering is consistent with the notion that the ease of decontamination decreases with increasing surface roughness.

iv. The DWPF waste is substantially easier to remove from all surfaces than the the Separations waste.

v. No effect of pressure was observed.

vi. It is easier to decontaminate a surface when it is greased than when not, but the difference is not great.

The supporting details are attached.

APPENDIX

1. The Data:

The experimental design consisted of all possible combinations of the treatments arranged as a full 2-level factorial in 3 variables (CONT, PRESS, GREASE) for each of the 5 levels of BASE, or 5*8 = 40 runs. Within each BASE, 4 of the 8 runs were duplicated giving an additional 4 runs per BASE so that the total number of runs was 40 + 4*5 = 60.

The dependent (measured) property was the % Reduction in Initial Radioactivity (y), or:

y = (Initial - After Cleaning)/ Initial as %.

The original raw data are attached as Table 1.

2. The Analysis:

The technique of Analysis-of-Variance is one whereby the total information (or variation) in the data is decomposed into 3 parts; that due to the variables under test (according to a simple linear model), that residual about the model due to pure experimental error (or noise), and that residual about the model due to departure of the model from reality (lack-of-fit). The component due to the test variables is further broken down into subcomponents, one for each term in the model involving one or more test variables. Specifically the model used is:

$$\hat{y}(hiklm) = m + B_h + C_i + P_k + G_l + BC_{hi} + BP_{hk} + BG_{hl} + CP_{ik} + CG_{il} + PG_{kl} + R_{hiklm}.$$

The "B's, C's, P's, G's" and their cross-products represent main effects and interactions of the test variables, "m" represents the overall average of the data, and "R" represents the residual.

It remains to estimate whether the "B's", for example, constitute an appreciable part of the total variation in the data when compared to that due to the residual "R". This is done by averaging over all the data within each BASE, and computing the variation of these resulting BASE averages about the grand mean of the data. A convenient way to do this locally is through the use of SAS PROC GLM which is a computer routine resident on the IBM 3081.

Initially the original, unedited data were treated. The overall decomposition showed that:

Source	Sum-of-Squares	Variance
Total	68,994.	
Model	59,135.	2,688.
Residual	9,859.	266.

Since the F-ratio of the Model Variance (2,688.) to the Residual

Variance (266.) is F = 10.1, and since this value corresponds to the .01 percentile (.0001), we conclude that the data show real trends of the test variables significantly over and above the noise level.

Since there then exists at least one term in the model which exhibits a real, non-zero effect, the question is, which one(s). The results shown in Table 2 substantiate that the following constitute real effects when their estimates are compared against the uncertainty in their estimation:

Source	Rank Order	Sum-of-Squares	F-ratio
CONT	1	43,014.	161.
CONT*GREASE	2	2,679.	10.
GREASE	3	2,311.	8.7
CONT*PRESS	4	1,334.	5.0
BASE	5	5,220.	4.9

The remaining terms are of magnitudes such that they are indistinguishable from noise. Hence, we conclude that the type of CONTamination dominates the data (Separations greatly more difficult to remove than DWPF), that the presence or absence of GREASE has an effect (greased surfaces more easily decontaminated), that there is an important interaction between the type of CONTamination and the presence of GREASE (the effect of grease is more pronounced with the Separations waste than with the DWPF), that there is another interaction between CONTamination and PRESSure (pressure has more effect on Separations waste than on DWPF), and that the kind of BASE is important.

For the multi-level variable BASE, the question remains as to which particular levels are responsible for the overall effect's being adjudged as significant. In the case of the 2-level variables this is self-evident. However, for the 5-level variable BASE, it is not. Seven statistical tests which reside in PROC GLM were used to conduct this "multiple comparisons test among means":

a. Least significant difference t-test
b. Duncan's multiple range test
c. Tukey's studentized range test
d. Studentized maximum modulus test
e. Sidak's t-tests
f. Bonferroni-Dunn t-tests
g. Scheffe's test.

The results were:

Test	Conclusion
a.	BASE5 & BASE3 > BASE1
b.	"
c.	BASE5 > BASE1
d.	"
e.	"
f.	"
g.	"

All others are indistinguishable statistically.

Finally, the residual variation was decomposed into 2 parts;

that due to irreproducibility (as measured by the disagreement between duplicates) and that due to lack-of-fit (by difference). The results were:

Source	Sum-of-Squares	df's	Variance
Residual	9858.89	37	
Pure Error	6181.76	20	309.09
Lack-of-Fit	3677.13	17	216.30

The F-ratio of Lack-of-Fit variance (216.30) to Pure Error variance (309.09) is < 1, so that we declare there to be no significant lack-of-fit; hence validating the model. However, most of the Pure Error sum-of-squares came from 4 sets of duplicates. The range in one of these sets of duplicates was nearly as large as the range over the whole experiment. Since this range was due to small changes in contamination, expressed as a percentage, the 2 values were replaced by their average and the analysis redone. In effect a sensitivity analysis was done to assess the effect on the "robustness" of the major conclusions to these 4 erratic(?) sets of duplicates.

The conclusions as to which effects are important remained the same as with the original data. However, since the large variances of the 4 sets were set to zero (a consequence of setting both of the duplicate values to the same value, their average), the Pure Error variance was substantially reduced, the Lack-of-Fit variance increased, and a significant lack-of-fit resulted. Hence, the sensitivity of the results to the spread in duplicates lies not in the major conclusions as to which variables are important but rather in the conclusion that the fitted model represents all the behavior of the system down to the basic irreproducibility of the data.

TABLE 1

THE RAW ORIGINAL DATA

BASE	CONT	PRESS	GREASE	y
base1	cont1	press1	grease1	80.0
base1	cont1	press1	grease1	86.7
base1	cont1	press1	grease2	92.0
base1	cont1	press2	grease1	91.7
base1	cont1	press2	grease2	92.3
base1	cont1	press2	grease2	75.0
base1	cont2	press1	grease1	28.6
base1	cont2	press1	grease1	16.7
base1	cont2	press1	grease2	0.0
base1	cont2	press2	grease1	14.3
base1	cont2	press2	grease2	14.3
base1	cont2	press2	grease2	0.0
base2	cont1	press1	grease1	78.3
base2	cont1	press1	grease1	85.7
base2	cont1	press1	grease2	81.8
base2	cont1	press2	grease1	83.3
base2	cont1	press2	grease2	83.3
base2	cont1	press2	grease2	88.5
base2	cont2	press1	grease1	0.0
base2	cont2	press1	grease1	85.7
base2	cont2	press1	grease2	0.0
base2	cont2	press2	grease1	14.3
base2	cont2	press2	grease2	0.0
base2	cont2	press2	grease2	14.3
base3	cont1	press1	grease1	85.0
base3	cont1	press1	grease1	86.4
base3	cont1	press1	grease2	95.0
base3	cont1	press2	grease1	95.5
base3	cont1	press2	grease2	95.0
base3	cont1	press2	grease2	96.0
base3	cont2	press1	grease1	42.9
base3	cont2	press1	grease1	83.3
base3	cont2	press1	grease2	42.9
base3	cont2	press2	grease1	28.6
base3	cont2	press2	grease2	14.7
base3	cont2	press2	grease2	66.7
base4	cont1	press1	grease1	75.0
base4	cont1	press1	grease1	80.0
base4	cont1	press1	grease2	75.0
base4	cont1	press2	grease1	90.0
base4	cont1	press2	grease2	89.5
base4	cont1	press2	grease2	88.9
base4	cont2	press1	grease1	57.1
base4	cont2	press1	grease1	66.7
base4	cont2	press1	grease2	33.3
base4	cont2	press2	grease1	57.1
base4	cont2	press2	grease2	33.3
base4	cont2	press2	grease2	16.7
base5	cont1	press1	grease1	88.9
base5	cont1	press1	grease1	88.9
base5	cont1	press1	grease2	90.0
base5	cont1	press2	grease1	100.0

base5	cont1	press2	grease2	100.0
base5	cont1	press2	grease2	100.0
base5	cont2	press1	grease1	50.0
base5	cont2	press1	grease1	83.0
base5	cont2	press1	grease2	16.7
base5	cont2	press2	grease1	100.0
base5	cont2	press2	grease2	16.7
base5	cont2	press2	grease2	33.3

TABLE 2

SAS 14:05 WEDNESDAY, MAY 9, 1984

GENERAL LINEAR MODELS PROCEDURE

ENDENT VARIABLE: Y

RCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
EL	22	59134.80383333	2687.94562879	10.09	0.0001	0.857105	26.6949
OR	37	9858.88600000	266.45637838		ROOT MSE		Y MEAN
RECTED TOTAL	59	68993.68983333			16.32349161		61.14833333

RCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE III SS	F VALUE	PR > F
E	4	5219.59733333	4.90	0.0029	4	5219.59733333	4.90	0.0029
T	1	43014.03750000	161.43	0.0001	1	43014.03750000	161.43	0.0001
SS	1	112.88816667	0.42	0.5191	1	36.08033333	0.14	0.7150
ASE	1	2310.89633333	8.67	0.0056	1	2310.89633333	8.67	0.0056
E*CONT	4	2661.93666667	2.50	0.0593	4	2661.93666667	2.50	0.0593
E*PRESS	4	325.91266667	0.31	0.8722	4	813.21466667	0.76	0.5561
E*GREASE	4	1442.02533333	1.35	0.2689	4	1442.02533333	1.35	0.2689
T*PRESS	1	1333.87350000	5.01	0.0314	1	295.16033333	1.11	0.2994
T*GREASE	1	2679.07500000	10.05	0.0031	1	2679.07500000	10.05	0.0031
SS*GREASE	1	34.56133333	0.13	0.7208	1	34.56133333	0.13	0.7208

ERVATION	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL
1	80.00000000	81.18000000	-1.18000000
2	86.70000000	81.18000000	5.52000000
3	92.00000000	86.44500000	5.55500000
4	91.70000000	83.97500000	7.72500000
5	92.30000000	92.46000000	-0.16000000
6	75.00000000	92.46000000	-17.46000000
7	28.60000000	26.09333333	2.50666667
8	16.70000000	26.09333333	-9.39333333
9	0.00000000	3.00833333	-3.00833333
10	14.30000000	19.47833333	-5.17833333
11	14.30000000	-0.38666667	14.68666667
12	0.00000000	-0.38666667	0.38666667
13	78.30000000	82.53000000	-4.23000000
14	85.70000000	82.53000000	3.17000000
15	81.80000000	83.19500000	-1.39500000
16	83.30000000	81.62500000	1.67500000
17	83.30000000	85.51000000	-2.21000000
18	88.50000000	85.51000000	2.99000000
19	0.00000000	36.97666667	-36.97666667
20	85.70000000	36.97666667	48.72333333
21	0.00000000	9.29166667	-9.29166667
22	14.30000000	26.66166667	-12.36166667
23	0.00000000	2.19666667	-2.19666667
24	14.30000000	2.19666667	12.10333333
25	85.00000000	86.39666667	-1.39666667
26	86.40000000	86.39666667	0.00333333
27	95.00000000	99.26166667	-4.26166667
28	95.50000000	82.89166667	12.60833333

GENERAL LINEAR MODELS PROCEDURE

'ENDENT VARIABLE: Y

;ERVATION	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL
29	95.00000000	98.97666667	-3.97666667
30	96.00000000	98.97666667	-2.97666667
31	42.90000000	59.64333333	-16.74333333
32	83.30000000	59.64333333	23.65666667
33	42.90000000	44.15833333	-1.25833333
34	28.60000000	46.72833333	-18.12833333
35	14.70000000	34.46333333	-19.76333333
36	66.70000000	34.46333333	32.23666667
37	75.00000000	80.46333333	-5.46333333
38	80.00000000	80.46333333	-0.46333333
39	75.00000000	77.02833333	-2.02833333
40	90.00000000	86.95833333	3.04166667
41	89.50000000	86.74333333	2.75666667
42	88.90000000	86.74333333	2.15666667
43	57.10000000	60.31000000	-3.21000000
44	66.70000000	60.31000000	6.39000000
45	33.30000000	28.52500000	4.77500000
46	57.10000000	57.39500000	-0.29500000
47	33.30000000	28.83000000	4.47000000
48	16.70000000	28.83000000	-12.13000000
49	88.90000000	93.33000000	-4.43000000
50	88.90000000	93.33000000	-4.43000000
51	90.00000000	74.97000000	15.03000000
52	100.00000000	112.15000000	-12.15000000
53	100.00000000	97.01000000	2.99000000
54	100.00000000	97.01000000	2.99000000
55	50.00000000	67.52666667	-17.52666667
56	83.00000000	67.52666667	15.47333333
57	16.70000000	20.81666667	-4.11666667
58	100.00000000	76.93666667	23.06333333
59	16.70000000	33.44666667	-16.74666667
60	33.30000000	33.44666667	-0.14666667

SUM OF RESIDUALS	0.00000000
SUM OF SQUARED RESIDUALS	9858.88600000
SUM OF SQUARED RESIDUALS - ERROR SS	-0.00000000
FIRST ORDER AUTOCORRELATION	-0.43974758
DURBIN-WATSON D	2.87935175