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WELDON SPRING SITE REMEDIAL ACTION PROJECT
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7295 Highway 94 South
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Document Number: 84872

▸▸Document Type: LR-ANL-DOEW

Originators DCN:

▸SUBJECT POSTCLEANUP RISK ASSESSMENT FOR THE SOUTHEAST DRAINAGE

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▸SUBJECT CODE/WORK PACKAGE NUMBER 02000

REFERENCED DOCUMENT(S)

ACTION ITEM TRACKING

INITIATE ACTION ITEM

INDIVIDUAL ASSIGNED TO ACTION DEPARTMENT

ACTION REQUIRED

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CLOSE ACTION ITEM

ACTION ITEM LOG NUMBER INITIATING DOCUMENT DIN

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84872

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September 14, 1999

Mr. Tom Pauling
U.S. Department of Energy
Weldon Spring Site Remedial Action Project
7295 Highway 94 South
St. Charles, MO 63304

Dear Tom:

Attached is a revised copy of the *Postcleanup Risk Assessment for the Southeast Drainage*. A change was made on the first page of the attachment where we have previously presented the postcleanup risk estimate for the hypothetical child scenario in Segment D to be 9×10^{-6} instead of 8×10^{-6}.

Please call me if you have any questions.

Sincerely,

Mary Picel

Mary Picel
ANL Project Manager

MP/pk
Encl.

023731

SEP 15 1999

ATTACHMENT: POSTCLEANUP RISK ASSESSMENT FOR THE SOUTHEAST DRAINAGE

This attachment presents the results of the postcleanup risk assessment performed for the Southeast Drainage. The purpose of the assessment was to determine the amount of risk reduction achieved by the removal action. Figure 1 depicts specific locations in the drainage that were remediated.

Postcleanup risk estimates for each segment are presented in Table 1. Risk calculations were performed using the same methodology and scenario assumptions (i.e., hypothetical child and recreational visitor/hunter scenarios) presented in the Engineering Evaluation/Cost Analysis (EE/CA) (DOE 1996b). The exposure routes evaluated include external gamma irradiation and incidental ingestion of sediment. Exposure point concentrations for sediment were calculated for each exposure unit (i.e., segment) by using the one-tailed 95% upper confidence limit (UCL) of the arithmetic average for each radionuclide. The summary statistics for each segment are based on location-specific data as presented in Table 2. Risk calculations for each segment were based on postremediation data from locations that were remediated, in combination with data from locations that were not remediated in the segment. (Note that some locations not targeted for cleanup because they are not accessible have contaminant concentrations that exceed risk-based cleanup criteria.) At locations where more than one sample was collected, the data were averaged to obtain a representative concentration for that location prior to aggregating the data for each segment. Additional volumes were removed from Location 60 in Segment D and Locations 101 and 132 in Segment B. For these locations, data collected after removal of the additional volumes were used in the calculations.

Estimated residual risk or postcleanup risk estimates for the hypothetical child scenario for Segments A through D are 2×10^{-5}, 2×10^{-5}, 1×10^{-5}, and 8×10^{-6}, respectively. These results indicate that the risk reductions achieved are equal to or greater than those projected in the EE/CA. Additional risk reduction was achieved in Segments C and D due to removal of 17 additional locations not planned for in the EE/CA because they were originally thought to be inaccessible. These additional locations were determined to be accessible during the field planning stage and were remediated.

Location-specific baseline (precleanup) and postcleanup risk estimates for the hypothetical child are also presented in Table 2. Of the 55 locations that were remediated, postcleanup risk estimates at 48 locations are at or below 1×10^{-5}, and 7 locations are near 1×10^{-5} (i.e., 2×10^{-5} at 5 locations and 3×10^{-5} at 2 locations) for the hypothetical child scenario. These results indicate that the removal action accomplished the goals presented in the Decision Document for the Southeast Drainage (DOE 1996a).

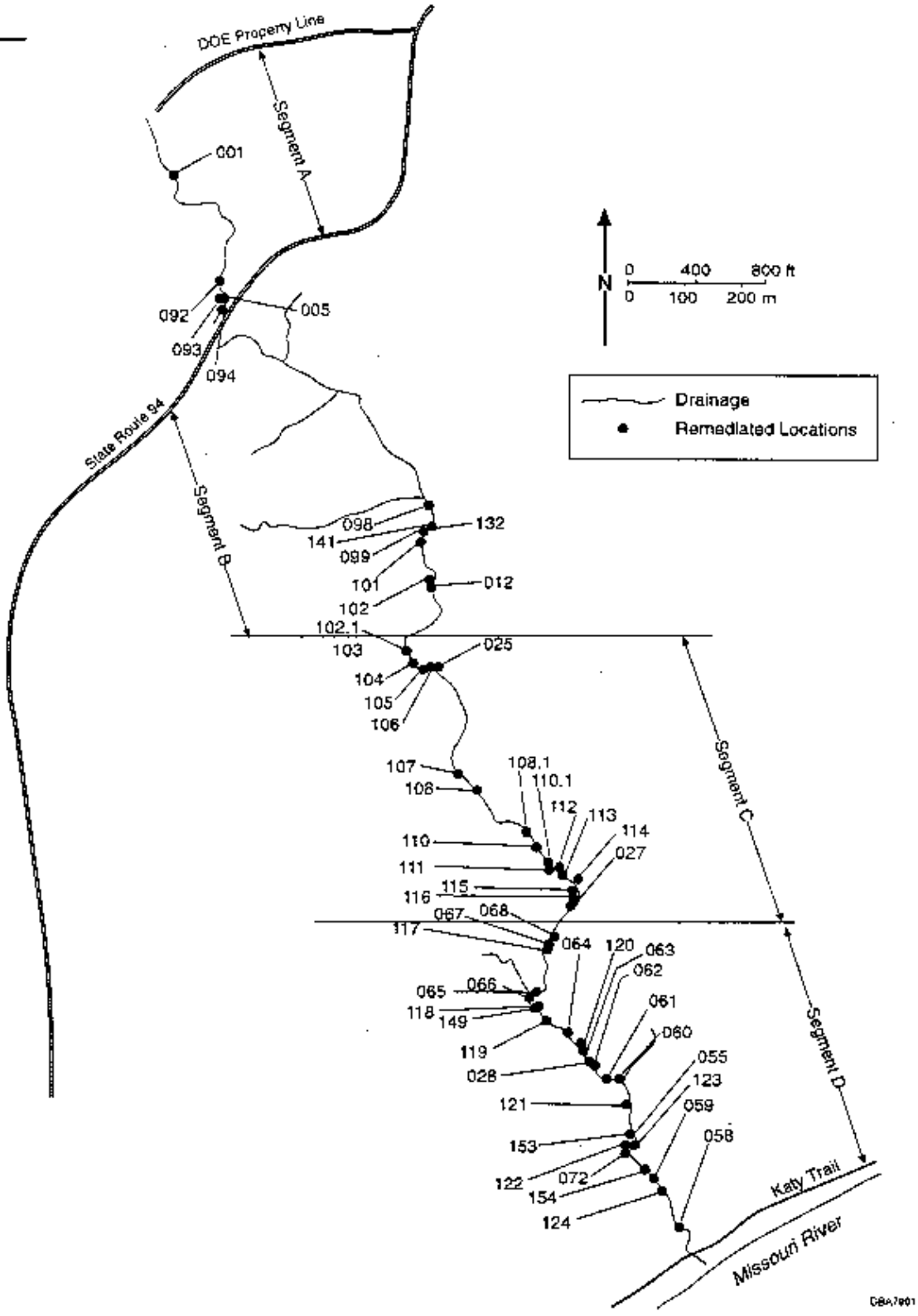

FIGURE 1 Remediated Locations in the Southeast Drainage

TABLE 1 Postcleanup Risk Estimates for the Southeast Drainage[a]

Segment		Summary Statistics[b]				Postcleanup	
		Ra-226	Ra-228	Th-230	U-238	Hypothetical[c] Child	Recreational Visitor/ Hunter[d]
A	Max. conc. (pCi/g)	39.0	5.0	38.0	200.0	2×10^{-5}	5×10^{-6}
	Min. conc. (pCi/g)	1.3	0.6	0.2	10.9		
	Avg. conc. (pCi/g)	15.8	1.8	12.4	52.4		
	St. dev	13.0	1.1	10.6	49.0		
	T-stat	1.753	1.753	1.753	1.753		
	Count	16	16	16	16		
	UCL[e] (pCi/g)	22	2.3	17	74		
B	Max. conc. (pCi/g)	110.0	4.0	39.0	59.0	2×10^{-5}	5×10^{-6}
	Min. conc. (pCi/g)	1.2	0.5	0.3	2.0		
	Avg. conc. (pCi/g)	14.7	1.4	11.1	16.6		
	St. dev	25.7	0.9	10.4	18.9		
	T-stat	1.740	1.740	1.740	1.740		
	Count	18	18	18	18		
	UCL[e] (pCi/g)	25	1.8	15	24		
C	Max. conc. (pCi/g)	36.0	6.6	45.0	74.0	1×10^{-5}	3×10^{-6}
	Min. conc. (pCi/g)	1.1	0.8	1.3	1.3		
	Avg. conc. (pCi/g)	8.2	1.6	7.8	14.8		
	St. dev	10.2	1.2	10.1	17.1		
	T-stat	1.717	1.717	1.717	1.717		
	Count	23	23	23	23		
	UCL[e] (pCi/g)	12	2.0	11	21		
D	Max. conc. (pCi/g)	27.0	6.7	120.0	70.0	8×10^{-6}	2×10^{-6}
	Min. conc. (pCi/g)	1.1	0.6	0.7	2.0		
	Avg. conc. (pCi/g)	6.2	1.6	16	12		
	St. dev	5.4	1.0	25.7	15		
	T-stat	1.684	1.684	1.684	1.684		
	Count	44	44	44	44		
	UCL[e] (pCi/g)	7.6	1.9	23	16		

[a] Postcleanup risk estimates for each segment were calculated by using the UCLs derived from all postcleanup data for remediated locations, combined with data from remaining locations in the segment that were not remediated.

[b] Summary statistics presented for each segment were developed from the location-specific data that constitute each segment, as shown in Table 2 of this attachment.

[c] The postcleanup risk estimates for the hypothetical child scenario were calculated using the same methodology and scenario assumptions presented in the EE/CA (DOE 1996). In the EE/CA, baseline (before cleanup) risk estimates and projected postcleanup risk estimates for this scenario were presented for each segment as follows:

TABLE 1 (Cont.)

Segment	Baseline Risk	EE/CA-Projected Postcleanup Risk
A	5×10^{-5}	2×10^{-5}
B	1×10^{-4}	3×10^{-5}
C	9×10^{-5}	4×10^{-5}
D	5×10^{-5}	2×10^{-5}

Postcleanup risk estimates for the hypothetical child scenario indicate that the removal action performed at the Southeast Drainage attained the projected postcleanup risks presented for Alternative 2.1 in Table A.4, page 57, of the EE/CA (DOE 1996).

d The postcleanup risk estimates for the recreational visitor/hunter scenario were calculated using the same methodology and scenario assumptions presented in the EE/CA (DOE 1996). In the EE/CA, baseline (before cleanup) risk estimates and projected postcleanup risks for this scenario were presented for each segment as follows:

Segment	Baseline Risk	EE/CA-Projected Postcleanup Risk
A	1×10^{-5}	5×10^{-6}
B	2×10^{-5}	6×10^{-6}
C	2×10^{-5}	9×10^{-6}
D	1×10^{-5}	5×10^{-6}

Postcleanup risk estimates for the recreational visitor/hunter scenario indicate that the removal action performed at the Southeast Drainage attained the projected postcleanup risks presented for Alternative 2.1 in Table A.3, page 57, of the EE/CA (DOE 1996).

TABLE 2 Location-Specific Data Summary and Risk Estimates for the Southeast Drainage

Segment	Location ID	Concentration (pCi/g)[a] Ra-226	Ra-228	Th-230	U-238	Risk Estimates: Baseline Hypothetical Child	Postcleanup Hypothetical Child
A	001[b]	12.3	1.6	4.7	37.8	9×10^{-5}	1×10^{-5}
	092[b]	5.4	1.5	38.0	80.0	2×10^{-6}	9×10^{-6}
	093[b]	1.9	1.2	0.8	76.0	2×10^{-5}	5×10^{-6}
	094[b]	3.8	1.2	8.9	17.0	1×10^{-5}	5×10^{-6}
	005[b]	4.7	2.9	22.9	10.9	2×10^{-4}	7×10^{-6}
	002	39.0	5.0	15.0	120.0	4×10^{-5}	-[c]
	003	39.0	1.4	31.0	200.0	4×10^{-5}	-
	004	17.0	2.7	11.0	50.0	2×10^{-5}	-
	016	7.0	1.5	14.0	17.0	8×10^{-5}	-
	017	11.0	1.4	1.4	15.0	1×10^{-5}	-
	018	1.3	0.8	0.2	16.0	2×10^{-6}	-
	087	15.0	0.6	6.8	47.0	1×10^{-5}	-
	088	30.0	2.8	11.0	43.0	3×10^{-5}	-
	089	11.0	1.3	5.1	31.0	1×10^{-5}	-
	090	33.0	1.3	14.0	48.0	3×10^{-5}	-
	091	22.0	1.2	14.0	29.0	2×10^{-5}	-
B	012[b]	1.7	1.1	10.0	2.0	4×10^{-5}	2×10^{-6}
	098[b]	2.5	1.1	3.7	2.5	3×10^{-4}	3×10^{-6}
	099[b]	2.5	1.2	2.5	3.0	5×10^{-5}	3×10^{-6}
	101[b]	5.9	0.7	34.2	2.8	2×10^{-4}	6×10^{-6}
	102[b]	2.8	1.3	6.4	9.9	2×10^{-5}	4×10^{-6}
	132[b]	5.3	0.5	39.0	8.4	1×10^{-4}	6×10^{-6}
	141[b]	2.1	0.9	4.9	2.9	5×10^{-5}	2×10^{-6}
	006	25.0	2.8	18.0	56.0	3×10^{-5}	-
	007	12.0	4.0	11.0	49.0	2×10^{-5}	-
	008	36.0	1.5	12.0	17.0	3×10^{-5}	-
	009	110.0	1.7	13.0	59.0	9×10^{-5}	-
	010	21.0	2.2	13.0	17.0	2×10^{-5}	-
	011	1.3	0.7	0.3	2.6	2×10^{-5}	-
	019	18.0	1.1	7.5	7.8	2×10^{-5}	-
	020	1.2	0.9	3.0	2.6	2×10^{-5}	-
	021	2.2	1.0	2.8	14.0	3×10^{-6}	-
	095	4.6	1.5	6.8	16.0	6×10^{-6}	-
	096	11.0	1.7	12.0	27.0	1×10^{-5}	-

TABLE 2 (Cont.)

Segment	Location ID	Concentration (pCi/g)[a] Ra-226	Ra-228	Th-230	U-238	Risk Estimates: Baseline Hypothetical Child	Postcleanup Hypothetical Child
C	025[b]	15.0	1.3	21.0	74.0	3×10^{-4}	2×10^{-5}
	027[b,d]	23.0	6.6	15.0	27.0	2×10^{-5}	2×10^{-5}
	102.1[b]	1.4	1.4	1.6	2.0	9×10^{-5}	2×10^{-6}
	107[b,d]	34.0	1.8	45.0	40.0	4×10^{-5}	3×10^{-5}
	108[b,d]	5.3	1.1	4.7	11.0	2×10^{-5}	5×10^{-6}
	108.1[b,d]	7.1	1.0	3.3	9.6	3×10^{-5}	6×10^{-6}
	110[b,d]	4.3	1.1	2.9	24.0	3×10^{-5}	5×10^{-6}
	110.1[b,d]	1.8	2.0	2.1	5.6	1×10^{-5}	3×10^{-6}
	111[b,d]	4.6	1.2	22.0	29.0	4×10^{-5}	6×10^{-6}
	112[b,d]	11.0	2.0	10.0	9.1	1×10^{-4}	1×10^{-5}
	113[b,d]	36.0	1.0	11.0	11.0	6×10^{-5}	3×10^{-5}
	114[b,d]	2.7	1.0	2.0	6.1	2×10^{-5}	3×10^{-6}
	115[b,d]	4.6	0.9	7.3	7.3	5×10^{-5}	5×10^{-6}
	116[b,d]	2.2	1.4	1.8	5.3	2×10^{-5}	3×10^{-6}
	103[b]	1.3	0.8	1.5	2.0	4×10^{-5}	2×10^{-6}
	104[b]	4.1	1.1	9.4	11.0	1×10^{-4}	4×10^{-6}
	105[b]	16.0	0.8	3.4	29.0	3×10^{-5}	1×10^{-5}
	106[b]	1.3	1.3	1.3	2.0	6×10^{-6}	2×10^{-6}
	049	6.5	1.7	1.3	26.0	8×10^{-6}	-
	143	1.8	1.6	4.6	3.7	3×10^{-6}	-
	144	1.1	1.5	2.4	1.4	2×10^{-6}	-
	145	1.3	0.9	4.6	2.3	2×10^{-6}	-
	146	1.4	2.6	1.7	1.3	3×10^{-6}	-
D	117[b,d]	9.4	1.6	12.0	10.0	9×10^{-5}	9×10^{-6}
	118[b,d]	17.1	6.7	60.0	69.5	2×10^{-5}	2×10^{-5}
	119[b]	1.5	1.0	0.7	10.6	2×10^{-5}	2×10^{-6}
	120[b]	8.8	0.6	2.4	2.0	1×10^{-4}	8×10^{-6}
	121[b]	14.9	1.1	7.8	10.6	2×10^{-5}	1×10^{-5}
	122[b]	1.7	1.4	1.1	2.7	3×10^{-5}	2×10^{-6}
	123[b]	5.0	1.1	7.1	3.8	5×10^{-5}	5×10^{-6}
	124[b]	6.7	1.6	12.4	9.4	1×10^{-4}	7×10^{-6}
	149[b]	10.4	1.4	18.2	34.2	2×10^{-5}	1×10^{-5}
	153[b]	7.3	1.2	3.5	6.4	9×10^{-6}	7×10^{-6}
	154[b]	5.1	1.5	8.6	8.3	5×10^{-6}	5×10^{-6}
	028[b]	11.0	2.0	3.2	3.7	3×10^{-6}	1×10^{-5}
	055[b]	4.3	1.0	5.6	8.8	2×10^{-5}	5×10^{-6}

TABLE 2 (Cont.)

Segment	Location ID	Concentration (pCi/g)[a] Ra-226	Ra-228	Th-230	U-238	Risk Estimates: Baseline Hypothetical Child	Risk Estimates: Postcleanup Hypothetical Child
Segment D (Cont.)							
	058[b]	5.0	1.2	2.9	5.0	5×10^{-5}	5×10^{-6}
	059[b]	4.9	2.0	46.0	10.0	5×10^{-5}	7×10^{-6}
	060[b]	16.8	1.0	49.7	12.1	5×10^{-5}	2×10^{-5}
	061[b]	27.0	1.0	18.0	70.0	8×10^{-5}	2×10^{-5}
	062[b]	1.3	1.1	1.3	2.0	1×10^{-5}	2×10^{-6}
	063[b]	11.0	2.0	3.2	6.1	5×10^{-5}	1×10^{-5}
	064[b]	2.9	1.3	4.7	10.0	2×10^{-5}	4×10^{-6}
	065	12.0	2.6	29.0	30.0	6×10^{-5}	1×10^{-5}
	066[b,d]	10.1	1.5	70.4	16.0	5×10^{-5}	1×10^{-5}
	067[b,d]	1.5	1.2	1.3	2.0	3×10^{-5}	2×10^{-6}
	068[b,d]	1.5	1.2	1.3	2.1	9×10^{-5}	2×10^{-6}
	072[b]	11.0	1.8	16.0	18.0	1×10^{-5}	1×10^{-5}
	026	3.6	1.4	95.0	10.2	7×10^{-6}	-
	030	2.4	1.4	6.5	2.9	3×10^{-6}	-
	050	9.3	1.0	6.8	7.7	9×10^{-6}	-
	051	8.2	3.2	120.0	33.0	1×10^{-5}	-
	052	1.9	1.3	4.3	5.7	3×10^{-6}	-
	053	5.6	1.2	8.9	23.0	7×10^{-6}	-
	054	2.1	1.2	4.1	3.3	3×10^{-6}	-
	056	3.9	1.3	11.0	16.0	5×10^{-6}	-
	057	2.7	1.3	3.8	3.6	3×10^{-6}	-
	069	1.5	1.3	2.9	4.1	2×10^{-6}	-
	070	3.6	1.3	15.0	6.4	5×10^{-6}	-
	071	1.6	1.1	3.6	5.5	2×10^{-6}	-
	073	1.5	1.0	3.3	3.8	2×10^{-6}	-
	074	1.5	1.1	2.7	4.2	2×10^{-6}	-
	147	1.6	3.3	4.0	2.9	4×10^{-6}	-
	148	1.1	2.6	3.2	2.2	3×10^{-6}	-
	150	3.3	1.9	9.1	11.0	5×10^{-6}	-
	151	5.3	2.9	12.0	14.0	7×10^{-6}	-
	152	3.8	2.6	3.1	6.2	5×10^{-6}	-

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TABLE 2 (Cont.)

[a] Radionuclide concentrations for each location represent postcleanup concentrations as presented in the *Closure Report for the Post-Remedial Sampling Plan of the Southeast Drainage* (DOE 1999) for those locations that were remediated and precleanup concentrations (as presented in the EE/CA [DOE 1996b]) for those locations that were not remediated.

[b] Remediated locations.

[c] A hyphen designates that the location was not remediated because it was inaccessible; therefore, the postcleanup risk would be the same as the baseline risk.

[d] The location was remediated but not originally identified for remediation in the EE/CA (DOE 1996b). Access to these locations was determined during the field planning phase.

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U.S. Department of Energy, 1996a, *Decision Document: Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Missouri*, DOE/OR/21548-584, Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, MO, Nov.

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