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OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

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J-6

STC-133

Mr. Dennis Lawyer
U.S. Nuclear Regulatory Commission, Region I
Division of Nuclear Materials Safety
475 Allendale Road
King of Prussia, PA 19406-1415

SUBJECT: FINAL CONFIRMATORY SURVEY PLAN FOR THE DEFENSE LOGISTICS AGENCY, DEFENSE NATIONAL STOCKPILE CENTER NEW HAVEN DEPOT, NEW HAVEN, INDIANA (RFTA NO. 09-013; DOCKET 040-00341) DCN 2001-PL-01-0

Dear Mr. Lawyer:

The Oak Ridge Institute for Science and Education (ORISE) is providing the enclosed final confirmatory survey plan for the Defense Logistics Agency's (DLA) Defense National Stockpile Center's (DNSC) New Haven Depot in New Haven, Indiana. Comments you may have will be incorporated into the final plan. The confirmatory survey is currently scheduled to commence on October 6, 2009.

Please direct any additional questions you may have to me at 865.241.8793 or Tim Vitkus at 865.576.5073.

Sincerely,

Evan Harpenau
Health Physicist/Asst. Project Leader
Survey Projects

EH:bf

Enclosure

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RADIOLOGICAL CONFIRMATORY SURVEY PLAN
FOR THE
DEFENSE LOGISTICS AGENCY
DEFENSE NATIONAL STOCKPILE CENTER
NEW HAVEN DEPOT
NEW HAVEN, INDIANA

INTRODUCTION AND SITE HISTORY

In 1946, a National Stockpile program began with the goal of mitigating dependence on foreign sources of vital materials during times of national emergencies. The New Haven Depot (NHV) in New Haven, Indiana, formerly the Casad Depot, stored 29 different types of strategic materials. The NHV is owned by the General Services Administration (GSA) and was operated by the Defense National Stockpile Center (DNSC).

Historically, the primary mission at the NHV was to store metallurgical ores and materials necessary for manufacturing defense and/or strategic materials. The DNSC has stored columbium/tantalum ores and concentrates, tungsten ores and concentrates, zirconium ore, rare earth sodium sulfate, monazite, tungsten metal scrap, and bastnasite throughout the various warehouses and outdoor areas of the NHV. These materials contained sufficient amounts of natural uranium and thorium to require licensing under NRC regulations and were stored by the DNSC in accordance with NRC License STC-133. Materials like zirconium ore were stored in outdoor piles while uranium and thorium were contained in wooden boxes and drums in designated bays within the warehouses located on the site. Specifically, the outdoor storage area for the licensed zirconium material was designated Pile 111 and located in the NHV open area designation, 7A. A portion of the zirconium in Pile 111 originated from DNSC depots in Jeffersonville, Indiana and Columbus, Ohio. Pile 111A contained the contaminated soil that was removed from the base of the former Jeffersonville and Columbus Depots zirconium piles and moved to NHV. All zirconium ore was sold in 2000 and loaded into railcars at an on-site rail siding. Some material was spilled during the loading operations and resulted in localized contamination of the associated land area. The largest accumulations of zirconium residue were identified on the paved road from Area 7A to the rail scale and the rail scale and the railroad tracks at the southern end of the Depot in front of Building 111. Other handling processes on the western side of the Depot resulted in the spillage of smaller more discrete accumulations of ore. The containerized licensed materials were stored in several warehouses on site designated as Warehouses 210 through 215 and other smaller buildings.

The DNSC is in the process of closing a number of depots across the country and requesting license amendments to remove those applicable depots from License STC-133. DNSC contracted with Cabrera Services to remediate remaining impacted areas of the NHV and to perform final status surveys (FSS). Prior to performing the FSS all licensed radioactive material (RAM) and residual licensed RAM on roadways and the surface of the ground were removed and the interiors of structures were remediated. The radionuclides of concern were natural thorium and uranium and the associated daughter products of the two decay series.

SITE DESCRIPTION

The New Haven Depot consists of 268 acres of land 3 miles east of Fort Wayne, Indiana off of State Route 14. There is a 6 foot high fence topped with barbed wire that surrounds the site. The site has a security officer controlling access, but is otherwise unoccupied. As discussed there are a number of large storage warehouses and other support buildings. The large warehouses are approximately 55 meters wide, 293 meters long and are framed with wood, concrete, or concrete-block that support wooden roof decks. Each warehouse is divided equally into four approximately 55-meter by 72-meter sections. Each section is then further subdivided into 79 equally sized storage bays. The other radiologically impacted buildings where RAM was handled and/or stored include buildings 136, 141, 145 (only the footprint remains) and 146. For the former exterior RMA storage piles, Pile 111 has a footprint surface area of 1,650 square meters; the Pile 111A footprint is $650m^2$.

OBJECTIVES

The objectives of the radiological confirmatory survey are to collect adequate radiological data for use in evaluating the radiological condition of New Haven Depot land areas, warehouses, and support buildings. The data generated will be used to validate the results of the Final Status Survey Report (FSSR) submitted by Cabrera Services stating all radioactive materials have been removed, remediation of the open land areas and structure surfaces is complete and the New Haven Depot meets the criteria for unrestricted use.

RESPONSIBILITY

Work described in the confirmatory survey plan will be performed under the direction of Tim Vitkus, Survey Projects Manager and Evan Harpenau, Asst. Project Leader of ORISE. The cognizant ORISE site supervisor has the authority to make appropriate changes to the survey procedures as deemed necessary, after consultation with NRC personnel. Changes to the scope of this survey plan or procedures will be documented in the site logbook.

DOCUMENT REVIEW

Review of the FSSR indicated that surveys were conducted using the guidance provided in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)." In most cases Cabrera followed the guidance provided in MARSSIM with one notable exception. It is ORISE's interpretation that instrument efficiencies did not account for the surface efficiency factor. In MARSSIM, total instrument efficiencies are determined based on the 2-pi instrument efficiency that is multiplied by a surface efficiency correction factor that is dependent upon the radiation type—alpha or beta emission—and the energy in the case of beta emissions. Instrument efficiencies determined using only the 4-pi activity of the calibration source will underestimate the total activity levels at measurement locations. Confirmatory surveys will be conducted in accordance to MARSSIM guidelines using total instrument efficiencies. This will result in higher activity levels for the confirmatory survey direct measurements results at any locations where above background activity may be present.

PROCEDURES

A survey team from ORISE will visit the New Haven Depot to perform visual inspections, and independent measurement and sampling activities. Confirmatory survey activities will be conducted in accordance with the ORISE/IEAV Survey Procedures Manual and the Quality Program Manual (ORISE 2008 and ORAU 2009). Because the RAM in the warehouses and other storage areas has been removed, there are no foreseeable implications to prevent proper scanning coverage and sampling of the impacted areas addressed in the FSSR.

ORISE will perform confirmatory surveys of Cabrera-designated survey units. Cabrera categorized FSS survey units in accordance with the three MARSSIM classifications, based on contamination potential, as either Class 1, 2, or 3. A description of each is as follows:

Class 1: Buildings or land areas that have a significant potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys) that exceeds the $DCGL_W$.

Class 2: Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the $DCGL_W$.

Class 3: Any impacted areas that are not expected to contain residual contamination, or are expected to contain levels of residual contamination at a small fraction of the $DCGL_W$.

HEALTH AND SAFETY

Potential health and safety issues of the project area will be identified and evaluated prior to confirmatory surveys. Additionally, the proposed survey and sampling procedures are evaluated to ensure that any hazards inherent to the procedures themselves are addressed in current job hazard analyses (JHAs). The procedures entail minimal potential hazards that are addressed in existing JHAs. Confirmatory survey activities will be performed in accordance with the ORISE IEAV general health and safety plan and the ORISE Radiation Protection Plan (ORISE 2005).

REFERENCE SYSTEM

ORISE will reference exterior survey results to prominent site features and/or global positioning system (GPS) coordinates. ORISE will reference building survey information to the building number, storage bay designation and/or specific X, Y coordinates from the southwest corner of the respective floor and lower left corner of walls. Information will also be plotted on site drawings.

Confirmatory surveys are planned to be completed for the survey units illustrated in Table 1 and Table 2. The tables indicate scan densities and scan types to be performed per survey unit.

BUILDING SURVEY PROCEDURES

Table 1. Building Scans

Survey Units	MARSSIM Classification	Survey Unit Size (m^2)	Scan Coverage (density)	Scan Type	
				alpha + beta	gamma
Structures					
129A-F	2	26	Medium	√	√
210-2-1	1	111	High	√	√
210-2-2	1	74	High	√	√
210-2-3	1	111	High	√	√
210-2-4	1	78	High	√	√
210-F	3	15,608	Low	√	√
210-W	3	1,795	Low	√	√
145-F	3	323	Low	√	√
215-4-F	3	4,013	Low	√	√

Surface Scans

Floors, lower walls, and other horizontal surfaces will be scanned for alpha plus beta and gamma radiation. Scans will be performed using NaI scintillation detectors for direct gamma radiation and gas proportional detectors for direct alpha plus beta radiation, coupled to ratemeters or ratemeter-scalers with audible indicators. Locations of elevated direct radiation will be marked for further investigation. Identification of areas requiring additional investigation will be based on instrument count rate action levels established at the site.

Surface Activity Measurements

Initially, construction material specific backgrounds will be determined in areas without a history of radioactive material use but of similar material and construction. If a similarly constructed non-impacted area cannot be identified, then ORISE may select an area for background measurements within the Class 3 survey areas (which may be the case for the warehouses). Selection of such an area will be based on program personnel experience and professional judgment as to the suitability of the area selected.

Direct measurements to quantify total alpha and/or beta activity levels will be performed at random locations within each survey unit selected for confirmatory survey. The number of random measurements—to evaluate a confidence interval of the mean concentration in each survey for comparison to the licensee's FSS result—will be calculated using the FSS data as inputs. Visual Sample Plan version 5.4.1 will be used to determine the number of measurements and to plot the locations. Measurement locations will be plotted using a quasi-random approach which minimizes spatial clustering of measurement locations. Judgmental direct measurements will be made at any locations of elevated direct radiation detected by surface scans. Direct measurements will be made using gas proportional detectors coupled to ratemeter-scalers.

EXTERIOR SURVEY PROCEDURES:

Table 2. Land Area Scans

Survey Units	MARSSIM Classification	Survey Unit Size (m^2)	Scan Coverage (density)	Scan Type	
				alpha + beta	gamma
Land Areas					
1	1	1949	High		√
2	1	1994	High		√
3	1	2026	High		√
5	1	1887	High		√
6	1	1435	High		√
4	2	5875	Medium		√
8	2	276	Medium		√
9	1	241	High		√
210-2-6	1	149	High		√

*Remaining Class 3 land areas will be judgmentally selected on-site for low density gamma scans.

Surface Scans

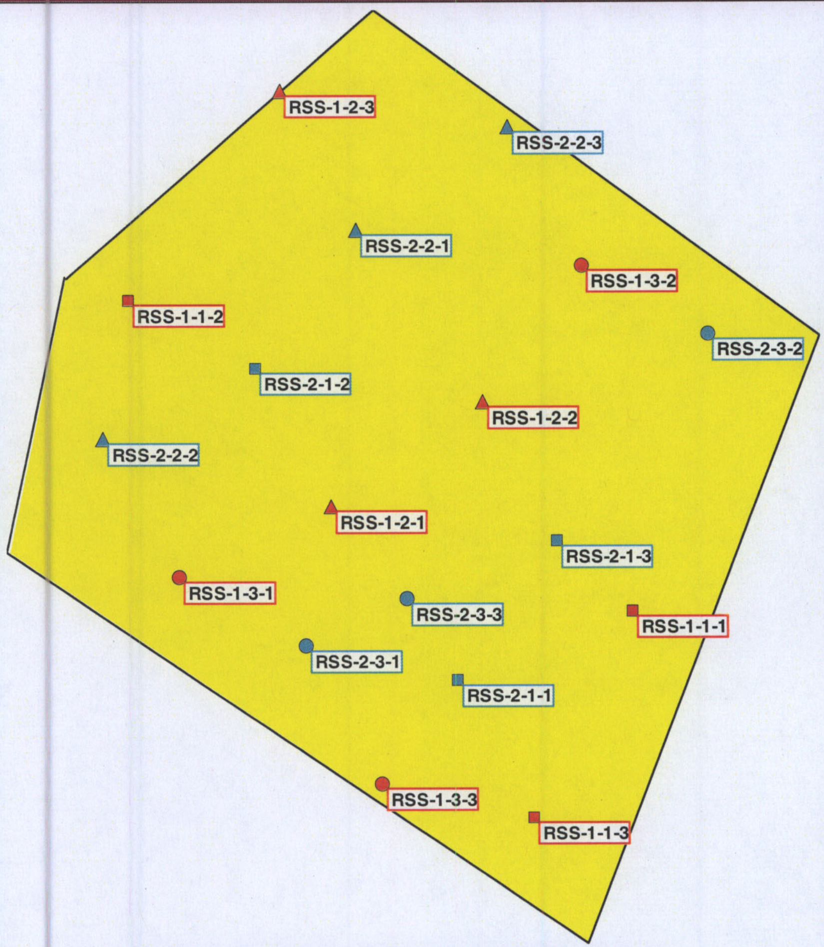
In addition to the scanning coverage described in Table 2, the remediated areas will be specifically scanned to verify remediation effectiveness. Scans will be performed using NaI scintillation detectors coupled to ratemeters with audible indicators coupled to GPS system that enables real time gamma count rate and position data capture. Locations of elevated direct gamma radiation will be marked for further investigation.

Soil Sampling

A ranked set sampling (RSS) approach will be used to design the confirmatory sampling plans for each of the selected survey units (EPA 2002). RSS provides a methodology to estimate the mean concentration of a population but does not require the assumption of a normal distribution. The process combines random sampling with the use of professional judgment to select sampling locations. Gamma one-minute static count data collected from a population of random locations will provide the measurable field screening method. The gamma count data will then be ranked to determine which location is sampled. The following example explains the process:

- The Visual Sampling Plan v.5.0, or higher, RSS module is used to determine the necessary number of measurement locations to estimate the mean. The number of measurements will be based on the expected standard deviation and desired confidence level of the estimated mean.
- For this example, assume that the systematic planning process resulted in $n = 6$ soil samples to estimate the mean.
- The next step is to use a replication process on a larger random population from which the locations for soil sampling and laboratory analysis will be selected.
- The replication process is referred to as a cycle, designated as r.
- Each cycle (r) consists of multiple sets; sets are designated as m.
- Each set (m) is comprised of a set size, or field assessment locations. The data from each set are ultimately the values that are ranked, for this example the ranked values are direct gamma counts. The set size should consist of from 2 to 5 field assessment locations. For this project a set size will consist of 3 locations, the gamma count data that are ultimately collected from the 3 locations associated with each set will be ranked as low, medium, or high. The three ranking categories establish the set size.
- The total number of repetitive cycles (r) is a function of n (6) and m (3)—or simply defined as $n = m \times r$. r for this example would therefore be 2 ($r = 6/3$).
- The number of field assessment locations per cycle, is a function of the set size and is simply m^2. The total number of field assessment locations is then defined as $m^2 \times r$ or in this example $3^2 \times 2 = 18$.
- The 18 locations are then both randomly grouped into cycle/sets and distributed in the survey area. The nomenclature for identifying a specific assessment location is cycle #-set#-arbitrary sequence # (1, 2, or 3). The first location in cycle 1 of set 1 would be designated as 1-1-1. Mapping is color coded (based on cycle ID) using geometric shapes (based on set ID) to visually show the population of assessment locations.
- Specific measurement locations will be generated via a quasi-random approach to prevent spatial clustering of the data over a probable heterogeneous distribution. Figure 1 represents a generic sampling plan for a group of three pipes for the above example.

Figure 1: Example with Ranked Set Sampling Locations



Example Survey Unit with RSS Locations

Cycle 1 Gamma Measurement Locations	Cycle 2 Gamma Measurement Locations
■, ▲, ● Set: 1, 2, 3	■, ▲, ● Set: 1, 2, 3

Gamma measurements are collected at each of the 18 assessment locations and the data within a given cycle-set are then ranked as exhibiting the lowest, medium, or highest gamma count. A soil sample is then collected in accordance with the following process within each of the 2 cycles: Set 1, lowest gamma radiation location; Set 2 medium location; Set 3 highest location. The potential to combine multiple land area survey units in a single sample design is possible if evaluation of the FSS data supports similar distribution of activity.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data will be returned to the ORISE laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses will be performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2009). Direct measurement results will be reported in units of disintegrations per minute per one-hundred square centimeters (dpm/100 cm^2). Soil samples will be analyzed by gamma spectroscopy for thorium and uranium. Soil sample results will be reported in units of picocuries per gram (pCi/g). Results will be presented in a draft report together with recommendations and provided to the NRC for review and comment. Data collected as part of this survey will be archived by ORISE. Confirmatory survey results will be compared with the following structural and soil DCGLs:

The DCGLs described in Tables 3-5 were approved by the NRC in October 2008 as site-specific release limits for the New Haven Depot. The unity rule was applied in the activity calculations for soil when concentrations of natural thorium and natural uranium were present.

Table 3. Soil $DCGL_w$

Nuclide	DCGLw (pCi/g)[1]
Natural thorium (^{232}Th+C)	2.5
Natural uranium (97.8% ^{238}U+C; 2.2% ^{235}U+C)	2.3

[1] Applies to any of the radionuclides in the ^{232}Th or ^{238}U decay series individually.

The final resultant surface DCGLs in Tables 4 and 5 were based on surface activity screening values from NUREG/CR-5512 that were further modified based on the total number of alphas emitted in each of the applicable decay chains and the percent contribution from each chain. Then applicable RAM fractions were applied for mixtures of materials stored in different areas of the site.

Table 4. Outdoor Area Alpha $DCGL_w$

Impacted Outdoor Areas	Alpha $DCGL_w$ (dpm/100cm^2)
Rail Scale	100
Entry Road and Paved Road to Rail Scale	100
Railroad Tracks Used for Shrink-wrapping	100
Railroad Tracks Used for Storage and Transport	100

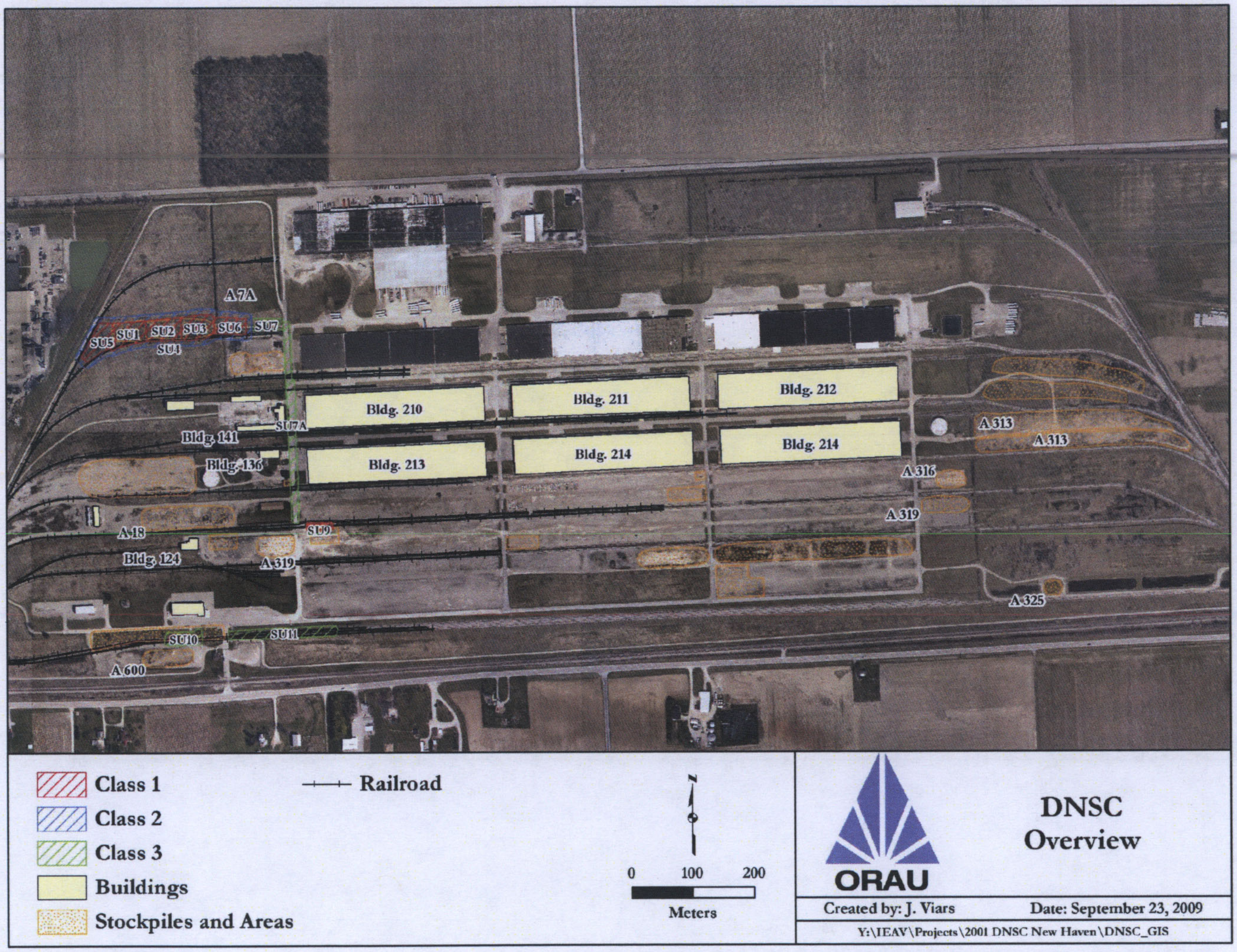
Table 5. Structure Alpha $DCGL_w$

Building	Impacted Structure Area	Alpha $DCGL_w$ (dpm/100cm^2)
124	All locations	100
129A	All locations	100
136	All locations	38
141	All locations	100
145 (footprint)	All locations	100
146	All locations	100
210	Sections 1, 2 and 3: All locations	38
	Section 4: Bays 2-5, 8, 9, 12-14, 32-33, 35, 43, 45, 46, 48, 52-54, 56, 58 and 76 only	100
211	Sections 1 and 2: All locations	55
212	Section 1: Bays 11, 31, 37, 41, 51, 61 and 71	100
	Section 2: Bays 11, 12 and 21	100
213	Section 1: All locations	38
	Section 2: Bays 12, 13, 15 and 16	38
	Section 3: Bays 1, 19, 21 and 29	100
	Section 4: Bays 1, 9, 11, 15, 21, 31, 38, 39, 41, 51, 59, 67, 69, 75, 78 and 79	100
214	Sections 1, 2 and 3: All locations	38
	Section 4: Bays 41-43, 45, 51, 59, 61, 69 and 75-79	55
215	Section 1: Bays 2-4, 11, 12, 13, 22, 23, 25-29, 34-37, 41, 43, 44, 45, 62 and 73-75	38
	Section 2: Bays 36, 41, 42, 46, 52-54, 62 and 63 only	38
	Section 4: Bays 15, 19, 29, 51-56, 61-65, 68 and 71-79 only	38

TENTATIVE SCHEDULE

Measurement and Sampling	October 2009
Sample Analysis	October 2009
Draft Report	Within six weeks of the completion of sample analysis

Figure 1: Conceptual Site Model



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