



Defense Threat Reduction Agency
8725 John J. Kingman Road, Stop 6201
Fort Belvoir, VA 22060-6201



DTRA-TR-19-039(R1)

TECHNICAL REPORT

Design Aspects of DTRA's NuTRIS-Web Software Application

Revision 1

DISTRIBUTION A. Approved for public release; distribution is unlimited.

October 2021

HDTRA1-15-C-0002

Prepared by:
CACI, Inc.
14370 Newbrook Drive
Chantilly, VA 20151

REPORT DOCUMENTATION PAGE*Form Approved*
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Service, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington, DC 20503.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY) 10-15-2021		2. REPORT TYPE Technical report		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Design Aspects of DTRA's NuTRIS-Web Software Application, Revision 1				5a. CONTRACT NUMBER HDTRA1-15-C-0002	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Siruvuri, Raju Giannelli, Priscilla Lentz, Mark				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) CACI, Inc. 14370 Newbrook Dive Chantilly, VA 20151				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Defense Threat Reduction Agency ATTN: RD-NTS (NTPR) LCDR James Franks 8725 John J. Kingman Road, Stop 6201 Fort Belvoir, VA 22060-6201				10. SPONSOR/MONITOR'S ACRONYM(S) DTRA RD-NTS	
				11. SPONSORING/MONITORING AGENCY REPORT NUMBER DTRA-TR-19-039(R1)	
12. DISTRIBUTION AVAILABILITY STATEMENT DISTRIBUTION A. Approved for public release: distribution is unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT DTRA's new Nuclear Test Review and Information System web application (NuTRIS-Web) provides expanded functionality for the Nuclear Test Personnel Review (NTPR) program's repository of atomic veteran information in support of veteran verification and associated radiation dose assessment. This document provides a comprehensive architectural and system design overview of NuTRIS-Web. It also provides an overview of the technologies used to develop and implement the application.					
15. SUBJECT TERMS NuTRIS-Web, Atomic Veterans, Solution Architecture, Technical Design, Data Model					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON LCDR James D. Franks, USN
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (Include area code) 571.616.6015
U	U	U	U	44	

STANDARD FORM 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

Table of Contents

LIST OF FIGURES.....	V
LIST OF TABLES.....	VI
REVISION NOTES.....	VII
ACKNOWLEDGEMENTS.....	VIII
SECTION 1. INTRODUCTION	1
SECTION 2. PURPOSE.....	1
SECTION 3. BACKGROUND.....	2
SECTION 4. TECHNICAL DESIGN GUIDELINES	5
4.1 GOALS	5
4.2 PRINCIPLES	6
<i>Guiding Principles</i>	6
<i>Design Principles</i>	6
SECTION 5. ARCHITECTURAL DESIGN	8
5.1 ASSUMPTIONS AND CONSTRAINTS	8
5.2 HARDWARE ARCHITECTURE	8
<i>Web Server</i>	8
<i>Database Server</i>	8
<i>File Server</i>	8
SECTION 6. SOFTWARE ARCHITECTURE	9
6.1 CLEAN ARCHITECTURE.....	9
<i>Dependency Inversion (DI)</i>	9
<i>Domain Driven Design (DDD)</i>	9
6.2 LAYERS.....	10
SECTION 7. SECURITY ARCHITECTURE	13
7.1 AUTHENTICATION.....	13
7.2 AUTHORIZATION.....	13
7.3 ENCRYPTION.....	13
SECTION 8. DATA ARCHITECTURE.....	13
SECTION 9. SYSTEM DESIGN	14
9.1 DESIGN CONSIDERATIONS	14
9.2 EXCEPTION HANDLING	14
9.3 HOSTING.....	14
9.4 SSL.....	15
SECTION 10. SOLUTION STRUCTURE	15
SECTION 11. DATA MODEL.....	17
11.1 PERSON DATA MODEL	17
11.2 DOSE DATA MODEL.....	18
11.3 CASE DATA MODEL.....	18
11.4 SERVICE DATA MODEL.....	19
11.5 WORKFLOW DATA MODEL	21
11.6 LEGACY DATA MODEL	22

11.7 USER DATA MODEL.....	22
11.8 NPRC	23
11.9 OUTREACH.....	24
11.10 OUTREACH AVSC	24
SECTION 12. ABBREVIATIONS, ACRONYMS AND SYMBOLS	26
SECTION 13. REFERENCES	27
APPENDIX A. USER INTERFACE DESIGN	28
APPENDIX B. ENGINEERING GUIDELINES	29
APPENDIX C. RELEASE NOTES.....	30

List of Figures

Figure 1: Clean Architecture.....	10
Figure 2: Solution Architecture	12
Figure 3: Http.Sys Server ^[R2]	15
Figure 4: Solution Structure.....	16
Figure 5: Person Data Model	17
Figure 6: Dose Data Model.....	18
Figure 7: Case Data Model	19
Figure 8: Service Data Model	20
Figure 9: Workflow Data Model.....	21
Figure 10: Legacy Data Model	22
Figure 11: User Data Model	22
Figure 12: NPRC Data Model.....	23
Figure 13: Outreach Data Model	24
Figure 14: Outreach AVSC Data Model.....	25

List of Tables

Table 1: Guiding Principles	6
Table 2: Design Principles	7
Table 3: Architectural Design - Assumptions.....	8
Table 4: Architectural Design - Constraints	8
Table 5: Design Considerations	14
Table 6: Acronyms List	26
Table 7: References.....	27

Revision Notes

This revision updates and expands technical information in the original version of DTRA Technical Report DTRA-TR-19-039, dated October 3, 2020. The revisions include addition of new modules, enhancements to existing modules, and implementation of bug fixes. The following are the new modules added during various releases starting from NuTRIS-Web version 1.3.0.

- NPRC
- Outreach
- Outreach - AVSC
- Legacy features
 - ECUP
 - Island Access
 - Bechtel
 - CIC
 - Issue Card

Additionally, this revision contains the data model updates for the above modules and all features deployed in each new release, which are summarized in Appendix C.

Acknowledgements

The authors gratefully acknowledge the superb peer review of this document by Aaron Parks of Applied Research Associates, Inc., Raleigh, NC and programmatic support by Dr. Paul Blake of DTRA's Nuclear Survivability Division. This work was performed under DTRA contract HDTRA1-15-C-0002.

Section 1. Introduction

This report discusses the technical aspects of the Defense Threat Reduction Agency's (DTRA) Nuclear Test Review and Information System (NuTRIS) Web application. The NuTRIS system was built and updated to fulfill one of the Nuclear Test Personnel Review (NTPR) Program's objectives to establish and maintain a comprehensive and accessible repository of DoD personnel involved in the U.S. nuclear tests and associated cleanups in addition to including historical and radiological information. The NTPR Program is responsible for identifying DoD personnel as participants in five missions:

- participants of U.S. atmospheric nuclear tests (1945 - 1962), conducted primarily in Nevada and the Pacific Ocean;
- post-World War II occupation forces of Hiroshima and Nagasaki;
- prisoners of war in Japan at the conclusion of World War II;
- participants of U.S. underground nuclear testing between (1951 - 1992), conducted primarily in Nevada; and
- participants of the radiological cleanup of the Bikini and Enewetak Atolls.

As of September 2021, there are approximately 551,791 personnel records contained in NuTRIS-Web, 492,286 of which are confirmed participants (59,505 non-participants).

The NTPR Program uses NuTRIS-Web to record participant data including radiation dose information and to perform case management activities tracking the veteran's claim for filing radiogenic disease compensation claims with the Department of Veterans Affairs, Department of Justice, and the Department of Labor.

Additional features in NuTRIS-Web include an electronic paperless case file workflow, the ability to track the status of any case file, links to veteran digitized personnel files, and case file metrics that track the number of open cases, cases in progress, and unassigned cases. Authorized users access NuTRIS-Web via a PC with internet connection and a DoD Common Access Card (CAC) into the DTRA unclassified network (UNET) domain.

Section 2. Purpose

This document describes the high-level system design and architecture using several different architectural views to depict different parts of the system. This document will be used to guide the iterative development of NuTRIS-Web.

Specifically, this document addresses the following questions:

- What are the architecture goals and constraints?
- What is the technical architecture for the system?
- What are the design and guiding principles?
- What are the design considerations?

Section 3. Background

NTPR Database

The original version of the NuTRIS system, known as the NTPR database, was used between 1983 and 1999 and supported by a Digital Equipment Corporation VAX/VMS mainframe operating system. The database contained participant and dose information for approximately 400,000 records of military and DoD civilians.

NuTRIS Database

In 1994, the NTPR Program initiated the development of a client-server system. This initiative would improve the NTPR Database functionality and user access to program data. The initial version of the new NuTRIS database, developed by Diverse Technologies Corporation (DTC), was delivered in October 15, 1997. JAYCOR, the support contractor, performed extensive testing and a functional assessment of the system. JAYCOR concluded the system did not provide all the functionality required to support the program. Furthermore, they found that the database structure could not effectively support the requirements and would need to be redesigned to increase the efficiency of the application, remove redundant data, and provide a more flexible approach to access data and incorporate future changes. Based on this feedback, JAYCOR was selected to undertake the effort to fully redesign the database structure, the functionality of the system, and the user interface.

NuTRIS PowerBuilder Application

In March of 1999, JAYCOR delivered version 1.0 of the NuTRIS PowerBuilder application. The new application included the complete functionality of the legacy NTPR system, a redesigned database, and access to the NuTRIS application from users' desktops. The NuTRIS database was built using a PowerBuilder front-end and an MS SQL Server database that ran on a Microsoft Windows-based platform. The application used PowerBuilder 12.6 and Microsoft SQL Server 2008 R2 and had approximately 48 screens, 45 reports and queries, and over 90 database tables.

NuTRIS-Web

In 2018, NTPR focused on modernizing the legacy NuTRIS PowerBuilder application to a web-based application using Microsoft .NET web technologies. On August 28, 2019, NuTRIS-Web version 1.0.0 went live. The new web application significantly reduced the number of screens and simplified navigation. A responsive layout was implemented to make web pages render on a variety of devices and screen sizes. The new system also mirrors the manual paper case filing system with an automated paperless case workflow and the ability to track the status of any case file.

The first major update, NuTRIS-Web version 2.0.0, was released on July 16, 2021. This update and the subsequent minor releases include addition of new modules, enhancements to existing modules, and the implementation of bug fixes. The following information in this section is a brief description of the new modules and significant enhancements to the NuTRIS-Web application. A full list of NuTRIS-Web release notes are provided in Appendix C.

NPRC Module

Research personnel performing research activities on NTPR claims order a wide variety of documents like service records, unit records, morning reports, flight logs etc. from the National Personnel Records Center (NPRC) in St. Louis. Researchers create the document requests in NuTRIS-Web by providing necessary information and start the record ordering workflow. Once a request is created, Record Analysts (RAs) working in St. Louis can view and bundle multiple requests in what is called a Submission. After a Submission is created, RAs will take a printout in an NPRC-acceptable format for collecting the documents from NPRC.

In NuTRIS-Web Version 2.0.0, NPRC features such as adding, editing, and deleting Unit and Personnel requests were added. Such requests, once created, can be searched by both Researchers and RAs using the search panel on the side menu. Required field validations make sure all the necessary information is provided by the Researchers when creating/modifying NPRC requests. Fields are toggled dynamically based on the type of request – Unit or Personnel. NPRC top navigation has two sub navigation items – Research and Records. All items created in the Research tab by the research team can be modified or deleted before submission to records team. RAs can view requests under this tab as read-only items. Similarly, once the requests are submitted, they will move to the Records tab and they are no longer available for edit or delete by the research team and only RAs can process them. They can be viewed by the research team as read-only items.

Once a new NPRC request is created and submitted by the research team, it will appear in the RA's queue for processing. RAs can bundle multiple requests into a Submission; they can modify specific elements of the request in the Submission. They can also add or delete items for the submission. After finalizing all the requests in a Submission RAs can take a printout in an NPRC-specified format for further processing at NPRC. Submissions are only applicable to Personnel requests; unit requests are processed separately, and they do not require a Submission.

Records are obtained by the RAs from NPRC after providing the paper copy of the Submission. They are scanned and uploaded to NuTRIS-Web under the respective NPRC request and sent back to the research team. Once back to the research team the documents will be used to further process the case and the workflow will be complete.

Outreach Module

Outreach is the final interactive module that was migrated from the legacy system to NuTRIS-Web. In this module members of the Case Administration team record the communication with the veterans, their next of kin, and government agencies. Each communication is recorded in detail in an Outreach record, where users enter information like date and time, veteran (or next of kin) name, and comments. All features related to Outreach were developed as a part of Version 2.2.0 and includes a new top navigation item. A list page displaying all the Outreach items and options to add, modify, and delete were created. Legacy data was migrated to the new data model created for Outreach.

Outreach-AVSC

Outreach-AVSC is a new module created in NuTRIS-Web to manage the outreach efforts performed for the Atomic Veterans Service Certificate (AVSC) program. Features related to this

module are released in version 2.3.0. As a part of this release a new sub navigation item (AVSC) was created under the top navigation item Outreach. To track the activities of Outreach-AVSC team at the State, Region, and County level a new drill down control was created.

Major features in this release include adding Offices and Call information at the three above mentioned levels. Users can add, edit, or delete Office information for a State, Region, or County. They can do so either by making an appropriate selection on the side menu or choosing them from the drop down while adding a new office. Validations are added while adding a new Office so that all the required information is captured. Different Office types can be added including but not limited to State, Congressional, and Senatorial.

Communication to and from the Outreach-AVSC team is recorded for the new Offices created. All the information related to the call is captured, e.g.the name of the person, their title, purpose, program, organization etc.

Legacy Modules

In Versions 2.4.0 and 2.5.0, final static legacy modules were migrated to NuTRIS-Web. These modules contain static data, and no new data was added from the system. All the features are therefore read-only, and no data model changes were made. Tables are migrated as is from the legacy database and only the names are modified to conform to the naming conventions of the NuTRIS-Web system. These legacy modules include Enewetak Cleanup (ECUP), Bechtel, Coordination and Information Center (CIC), and Issue Card.

ECUP information resulted from a data entry effort when research and dose assignment for veterans of the Enewetak Cleanup activities in the Marshall Islands from 1977 to 1980 became a responsibility of the NTPR program. In the legacy system, information was captured from the atoll arrival and departure cards and later added information regarding controlled island access, protection levels, and daily activities. It is a separate event from the atomic testing programs. Access to the Bechtel information provides original badged dose data and some reconstructions collected at the test site. The Issue Card has dose information on microfilm, with such things as the reel numbers specified. CIC allows for thorough searches of the Nuclear Testing Archive microfilm records collection by providing information such as microfilm reel and frame numbers, document titles and numbers, and name-in-text results.

As with most of the modules in NuTRIS-Web, information in these modules were presented in the form of lists that span across multiple pages. Information can be filtered using the search options available on the side menu or the filter and sort option available at the top of the data grids. Data from these modules is only available as read-only data and cannot be modified.

Enhancements

Created a new user role named Document Administrator (DA). The new user role allows the user to modify and delete documents. Also, as a part of document management, users with appropriate privileges can modify a document name after it is uploaded.

Section 4. Technical Design Guidelines

This section provides an overview of the architectural goals and describes the guiding design principles taken into consideration while designing and developing NuTRIS-Web solution.

4.1 Goals

The overall architectural goal of the system is to provide a highly available, scalable NuTRIS-Web interface by utilizing industry best practices including development guidelines, design patterns, and the latest .NET Core framework. Additional design goals include

- **Scalability:**

Scalability is the application's ability to scale both up and down to support varying numbers of users or transaction volumes. The application design should support n-tier environment. The application should be able to scale horizontally (by adding more servers) or vertically (by increasing hardware capacity or software efficiency).

- **Flexibility:**

Flexibility is the application's ability to accommodate new requirements without affecting the existing operations. This relies on a modular architecture, which isolates the complexity of integrating presentation and business logic from each other in order to allow for the easy integration of new technologies and processes within the application.

- **Manageability:**

Designing an application for manageability involves providing an information infrastructure that allows the application and all its important supporting services and devices to be monitored for possible corrective and preventive action.

- **Extensibility:**

Extensibility is the capacity to add new functionality to the development environment. It is also the ability to dynamically introduce new functionality. Extensibility can be achieved by using concepts, such as inversion of control and dependency injection patterns.

- **Availability:**

Availability is the ability of the system to be in a state to perform a required operation at a given instance of time assuming that the external resources are provided. Using layered architecture and developing high-quality code in addition to fail-safe infrastructure design will help ensure high availability.

4.2 Principles

Guiding Principles

The NuTRIS-Web architecture is designed according to the guiding principles in Table 1.

Table 1: Guiding Principles

No.	Principle	Description
1	Design and Develop Application Software Components for Reusability while promoting continuous improvement of processes	This principle emphasizes two main characteristics of open systems standards: designing application software as components of an overall system and designing components for reusability. Together, these concepts constitute the minimum requirements for designing and deploying adaptable IT solutions that can evolve with the business needs.
2	Design and develop application using the Clean architecture model	This principle emphasizes partitioning the concerns of the application into stacked groups (layers). Layered architecture focuses on the grouping of related functionality within an application into distinct layers that are stacked vertically on top of each other. Functionality within each layer is related by a common role or responsibility.
3	Utilizing the pluggable Kendo UI products	This principle emphasizes using the pluggable Kendo UI products to reduce the development time in a cost-effective manner.
4	Promote the Use of Web based Technology	The Internet and its related web-based technologies are the most significant advancements in information systems to occur in the last decade. The Internet, intranets and extranets offer new channels for enhanced communications directly between customers and suppliers. As web-based technologies continue to rapidly evolve, they are setting new standards and changing paradigms for using computers and networks to solve business problems.

Design Principles

The NuTRIS-Web architecture follows design principles described in Table 2.

Table 2: Design Principles

No.	Principle	Description
1	Separation of Concerns	The application has to be divided into distinct features with as little overlap in functionality as possible. The important factor is minimization of interaction points to achieve high cohesion and low coupling. However, separating functionality at the wrong boundaries can result in high coupling and complexity between features even though the contained functionality within a feature does not significantly overlap.
2	Persistence Ignorance (PI)	PI allows business entities to be persisted without the underlying knowledge of the caching technology. Types that implement PI in .NET can be referred as Plain Old CLR Objects or POCOs.
3	Dependency Inversion (DI)	Modules within the application should depend on abstraction rather than concrete implementation. This can be achieved by using a DI framework. DI is key when developing loosely coupled applications.
4	Single Responsibility Principle	Each component or module should be responsible for only a specific feature or functionality, or aggregation of cohesive functionality.
5	Do not repeat yourself (DRY)	Intent has to be specified in one place. For example, in terms of application design, specific functionality should be implemented in only one component; the functionality should not be duplicated in any other component.
6	Test-Driven Development (TDD)	In TDD, tests will be written before the code has been developed for a given requirement. This approach reduces bugs in the system and makes refactoring of code easier.
7	Well-Defined Interfaces	A component should not know the internal workings of another component and should only communicate via an agreed upon interface or contract. This helps ensure that the solution is easy to maintain and extend.
8	Bounded Context	In Domain Driven Design, Bounded Context defines a clear boundary for each business model. By using repository and factory patterns, interactions with the domain models can only happen within this boundary.

Section 5. Architectural Design

This section outlines the system and hardware architecture design of NuTRIS-Web.

5.1 Assumptions and Constraints

The following tables list the architectural assumptions and constraints for NUTRIS-Web.

Table 3: Architectural Design - Assumptions

Assumptions	Comments
.NET Core 2.2 framework will be used on the project.	
Entity Framework Core will be utilized on the project.	Entity Framework Core is offered as a NuGet package from Microsoft.
NTPR staff will use Google Chrome browser.	NuTRIS-Web system can be best viewed in Google Chrome browser.

Table 4: Architectural Design - Constraints

Constraints	Comments
Uploaded files cannot be viewed in Google Chrome browser.	Files uploaded to NuTRIS-Web should be downloaded before they can be viewed.

5.2 Hardware Architecture

NuTRIS-Web is hosted within DTRA's network (UNET).

Web Server

NuTRIS-Web application is hosted on a Windows 2016 Core Server running Http.sys, which acts as a Web Server for the ASP .NET core application.

Database Server

SQL Server 2016 acts as the Database server where the data is stored. As the legacy NuTRIS PowerBuilder application's data is stored in an older version of SQL Server and since it will be easier to migrate the data from the old system, SQL Server has been selected as the data store for NuTRIS-Web application.

File Server

Files uploaded to the NuTRIS-Web application are saved to the File Server which runs Windows 2016 Core.

UNET network users who are located at DTRA can connect to NuTRIS-Web application directly through a web browser using Windows authentication. External users should connect to UNET through Global Protect VPN using CAC for authentication; once connected, they will be able to access NuTRIS-Web same as internal users.

Section 6. Software Architecture

The NuTRIS-Web software architecture is designed to meet all the technical and operational requirements while optimizing common quality attributes, such as performance, security, and manageability. Building the system involves a series of decisions based on a wide range of factors. Each of these decisions can have considerable impact on the quality, performance, maintainability, and overall success of the application.

NuTRIS-Web employs Clean architecture as well as other methodologies such as component-based architecture and object-oriented architecture.

6.1 Clean Architecture

In Clean architecture, complexity of the application is separated into responsibilities and concerns. The architecture primarily consists of Dependency Inversion (DI) and Domain Driven Design (DDD).

Dependency Inversion (DI)

When developing a software solution, the business requirements are broken into smaller components. As the size of the solution increases so does the dependencies between the components. If the dependencies are concrete and rigid, maintaining and testing the components will be very difficult. The two main principles of DI are^[R1]:

- High-level modules should not depend on low-level modules. Both should depend on abstractions (e.g., interfaces).
- Abstractions should not depend on details. Details (concrete implementations) should depend on abstractions.

Domain Driven Design (DDD)

DDD is a software philosophy where models are designed to closely mimic the underlying business processes and the relationship between them is explicitly defined. A Domain is a business area within which entities and functions are clearly defined. Bounded context defines a tangible boundary around the domains.

Clean architecture focuses on the grouping of related functionality within NuTRIS-Web into distinct layers that are stacked vertically. Layering the application appropriately helps to support a strong separation of concerns, which, in turn, supports flexibility and maintainability. The layers of the application may reside on the same physical computer (the same tier) or may be distributed over separate computers (n-tier), and the components in each layer communicate with components in other layers through well-defined interfaces/classes.

NuTRIS-Web architecture is divided into the following layers:

- Presentation or UI Layer
- Application Core Layer
- Infrastructure Layer
- Data Layer

Each Layer in a Clean architecture solutions has its responsibility clearly defined.

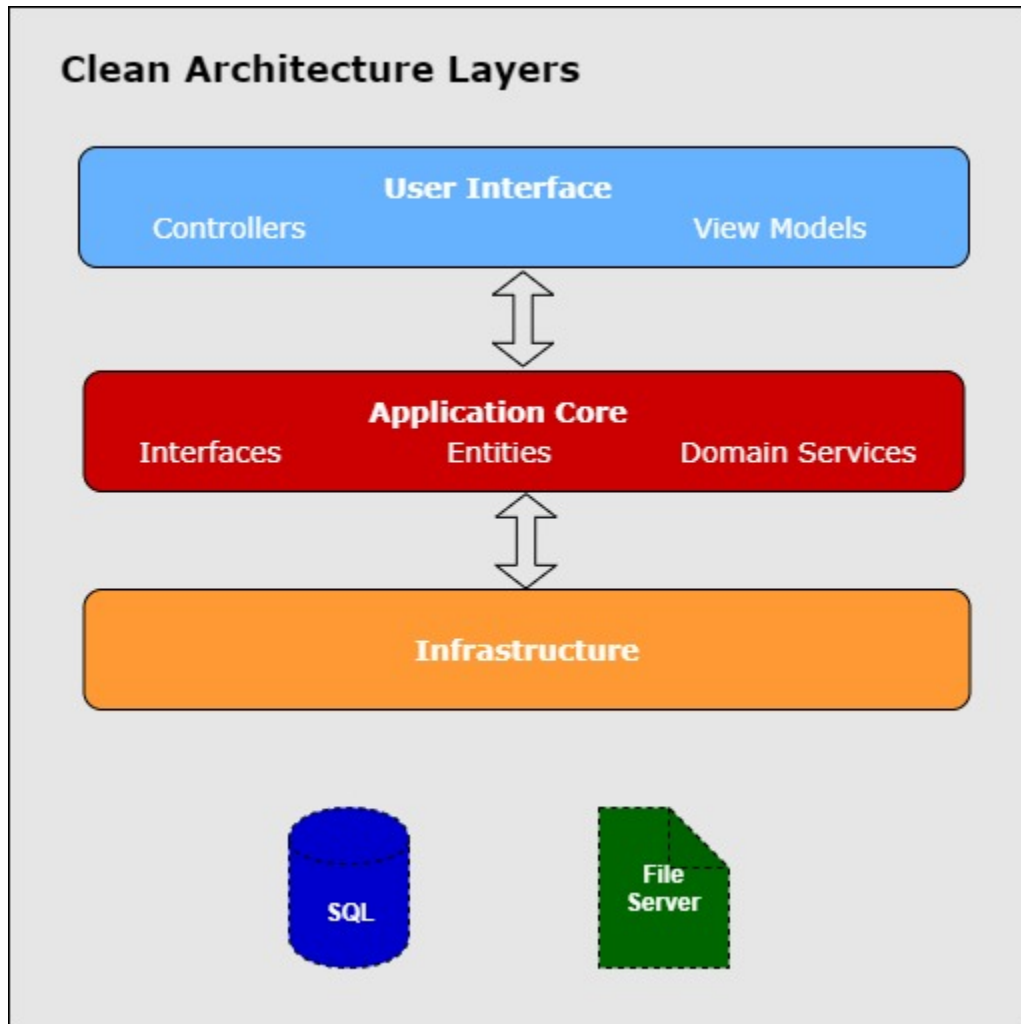


Figure 1: Clean Architecture

6.2 Layers

Presentation Layer

The presentation layer contains the components that implement and display the user interface and manage user interaction.

NuTRIS-Web presentation layer contains the following components:

- **User interface components:**

User interface components are a set of components that manage the display of information and allows the user to interact with the system. User interface components will be implemented in NuTRIS-Web .NET Core Razor Pages and Vue.js Pages. These components are generally referred to as “Views” and perform the operations of acquiring and displaying the data to the user.

These components are responsible for:

- Using appropriate controls and validations for data input.
- Managing visual layouts, styles, and the general appearance and navigation of the application.
- Formatting, organizing data, and displaying it in useful visual styles.

- **User interface process components:**

These components orchestrate the user interface elements and control user interaction. Users do not see user interface process components; however, these components perform a vital supportive role to user interface components. These components are generally referred to as “Application controllers” and manage the control flow in a given execution of a use case.

- Managing control flow through the user interface components involved in a use case.
- Encapsulating how exceptions affect the user process flow.
- Maintaining internal business-related state, usually holding on to one or more business entities that are affected by the user interaction.

Application Core

The Application Core holds the business model, which includes entities, repositories, interfaces, and services. The Application Core layer is responsible for processing the application business logic. In NuTRIS-Web, the business layer is represented as a class library. The business logic is defined as any application logic that is concerned with the retrieval, processing, transformation, and management of application data; application of business rules and policies; and ensuring data consistency and validity.

NuTRIS-Web business layer contains the following components:

- **Domain Entities and Repositories:**

Domain entities store data values and expose them through properties; they contain and manage business data used by an application and provide stateful programmatic access to the business data. Business entity components will be implemented in NuTRIS-Web as standalone classes (referred to as a “Class Library”) and are responsible for processing

the application logic and maintaining the application data. Business entity components are responsible for:

- Sequencing calls to other business logic or data access logic.
- Initiating and controlling business logic transactions.

- **Business Logic:**

Business logic comprises the business rules pertaining to a business entity, for example calculation or conditional logic.

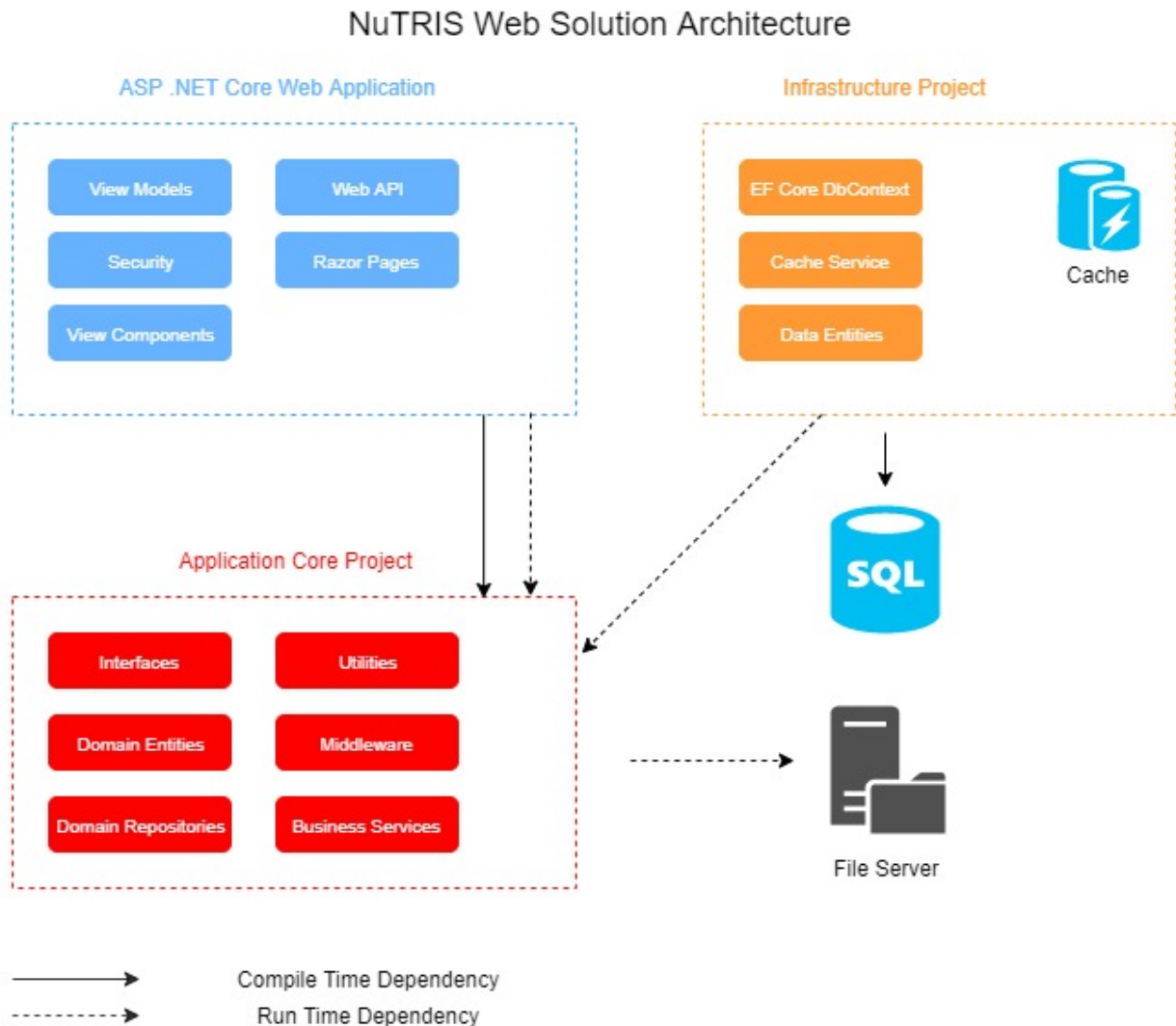


Figure 2: Solution Architecture

Infrastructure Layer

The Infrastructure Layer will typically include data access implementations. In a typical ASP.NET Core web application, this will include the Entity Framework (EF) DbContext, any

EF Core Migrations that have been defined, and data access implementation classes. The most common way to abstract data access implementation code is with the Repository design pattern. Repository design pattern provides a clean separation between the database objects and the domain layer. The Repository encapsulates the data objects and the Create, Read, Update, Delete operation performed over them via interfaces.

Data Layer

The data layer hosts the data access components to access the underlying data stores. The data access components centralize the common data access functionality in order to make the application easier to configure and maintain. The Platform framework will provide the data layer for NUTRIS-Web.

Section 7. Security Architecture

7.1 Authentication

Authentication is the process of verifying the identity of the system user typically by username and password. Since NuTRIS-Web is an intranet application and all its users are Windows users, the system authenticates using the Windows user name.

7.2 Authorization

After successful authentication of the system user by the web server, authorization determines access to the web resources for the authenticated user. This is achieved by role-based authorization where user roles and the actions they can perform on each web page are clearly defined. Authentication and Authorization can be managed through the Administration portal in NuTRIS-Web.

7.3 Encryption

ASP .NET Core framework provide APIs to secure sensitive data during transmission. URLs containing sensitive data are encrypted using .NET Core framework libraries. Sensitive data at rest will be encrypted using database encryption.

Section 8. Data Architecture

The NuTRIS-Web data architecture defines how the data is stored, managed, and used in the system. It establishes common guidelines for data operations that make it possible to predict, model, gauge, and control the flow of data in NuTRIS-Web.

NuTRIS-Web Database

The NuTRIS-Web database is designed for the day-to-day operational needs of the business and optimized for online transaction processing (OLTP).

Section 9. System Design

This section describes the concrete implementation of the architecture design at the component and the object level.

9.1 Design Considerations

The following design considerations were implemented in the NuTRIS-Web architecture.

Table 5: Design Considerations

No.	Consideration	Rational
1	Implementation of the Presentation layer using the user interface components and process components.	The NuTRIS-Web presentation layer is implemented using the interface components and processes provided by .NET Core. These components make the UI layer highly maintainable and easily testable.
2	Implementation of the business layer using business logic and entities.	The NuTRIS-Web business layer is implemented using the business logic and entities. Business entities provide abstraction of the business rules and facilitate good design.

9.2 Exception Handling

Exception Handling is the process of gracefully handling runtime errors by providing meaningful notifications for the end users and logging the errors for later review by technical staff. NuTRIS-Web records diagnostic logs from the system to a SQL Server database using Serilog.

9.3 Hosting

ASP .NET Core offers multiple hosting options on different operating systems. In a Windows environment the following are the web servers available:

- Kestrel
- IIS
- Http.Sys

NuTRIS-Web uses Http.Sys as the web server on a Windows server. It supports Windows authentication; Kestrel doesn't. Since reverse proxy is not needed, Http.sys has been chosen over IIS. HTTP.sys is production ready technology and runs in its own process. It protects against many types of attacks and is robust, secure and scalable

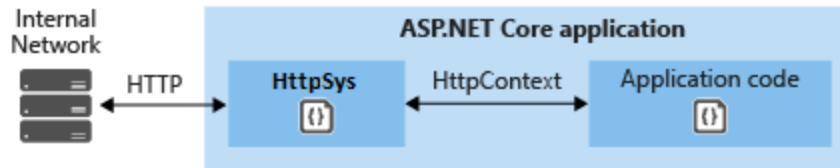


Figure 3: Http.Sys Server ^[R2]

9.4 SSL

Communication with NuTRIS-Web will be secured using HTTPS protocol. HTTPS encrypts the data between the browser and the web server by using SSL. ASP .NET core web server will be configured to use a digital SSL certificate and HTTPS over the port 443.

Section 10. Solution Structure

The Nutris-Web solution consists of three projects separated by their respective architectural responsibility. Even though the solution has three projects, it is deployed as a single web site through which users will interact.

Infrastructure Project

The infrastructure project consists of data access logic with POCO classes generated by Entity Framework. Manual code changes are never permitted in this project as they will be overwritten when new code is generated using EF commands to reflect changes in the data model.

Application Core Project

The domain layer which is part of the application core project consists of entities and repositories with Create, Read, Update, Delete operations defined; service layer classes defines the core business logic. Data transformation of objects between the layers is achieved using AutoMapper. Utilities, which has classes containing common functionality, and Middleware classes used in ASP .NET Core are part of the application core project.

Web Project

The web project primarily consists of UI elements – HTML Pages, Razor Pages, JavaScript files, CSS files, images, Kendo UI framework files. The security module which is responsible for the authentication and authorization of the web site resides in this project. View Models which are an abstraction of UI elements are stored in a separate folder. The configuration files hold information such as connection strings, file server paths etc. Dependency injection services are defined in the startup class; the web project acts as the entry point for the NuTRIS-Web application.



Figure 4: Solution Structure

Section 11. Data Model

11.1 Person Data Model

Figure 5 represents the Person data model and its direct table relationships. The tables capture general personnel information (i.e., address, phone, SSN, etc.) about the veteran.

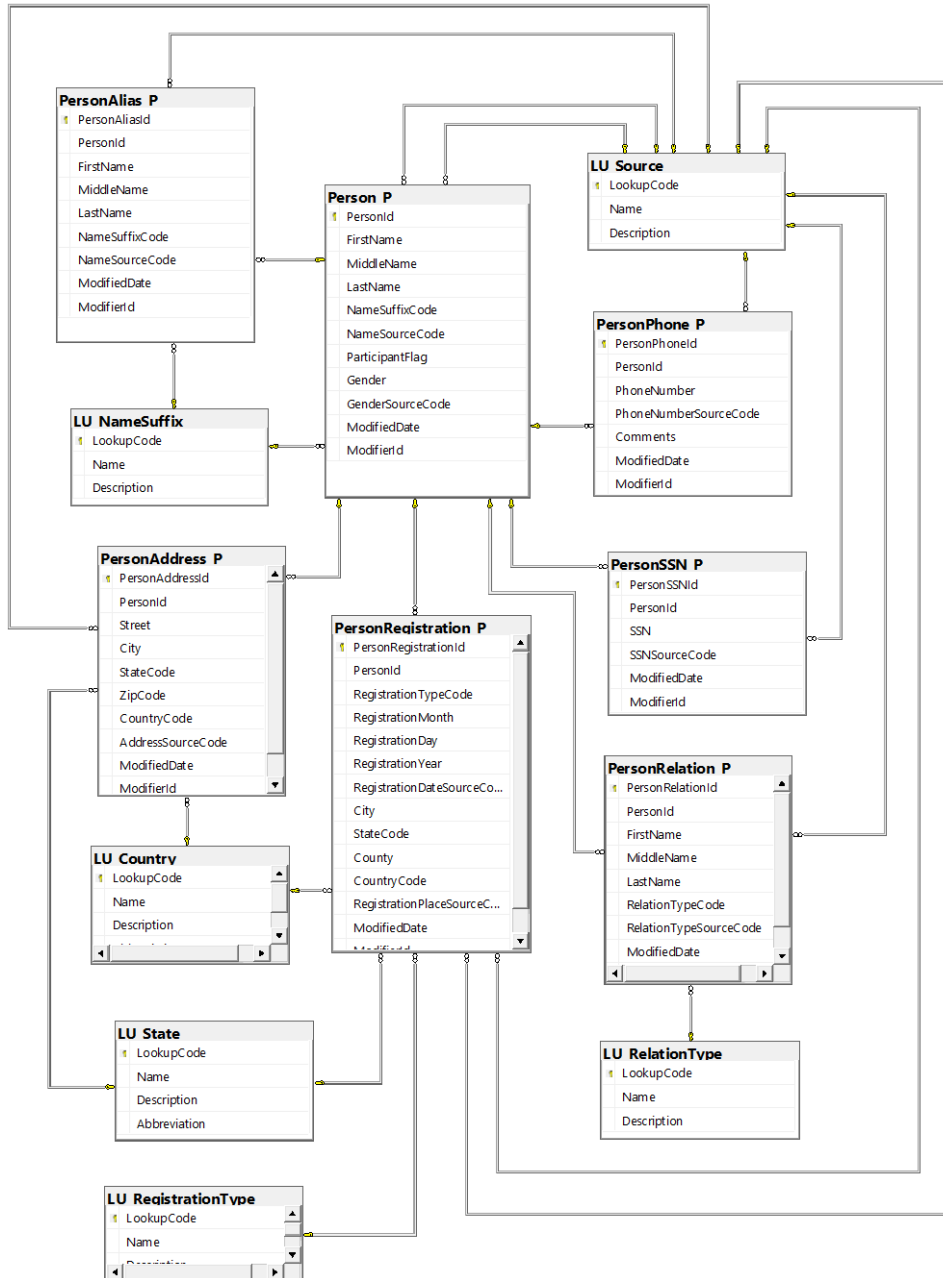


Figure 5: Person Data Model

11.2 Dose Data Model

Figure 6 represents the Dose data model and its direct table relationships. The tables contain information about the level of radiation the veteran was exposed to both internally and externally.

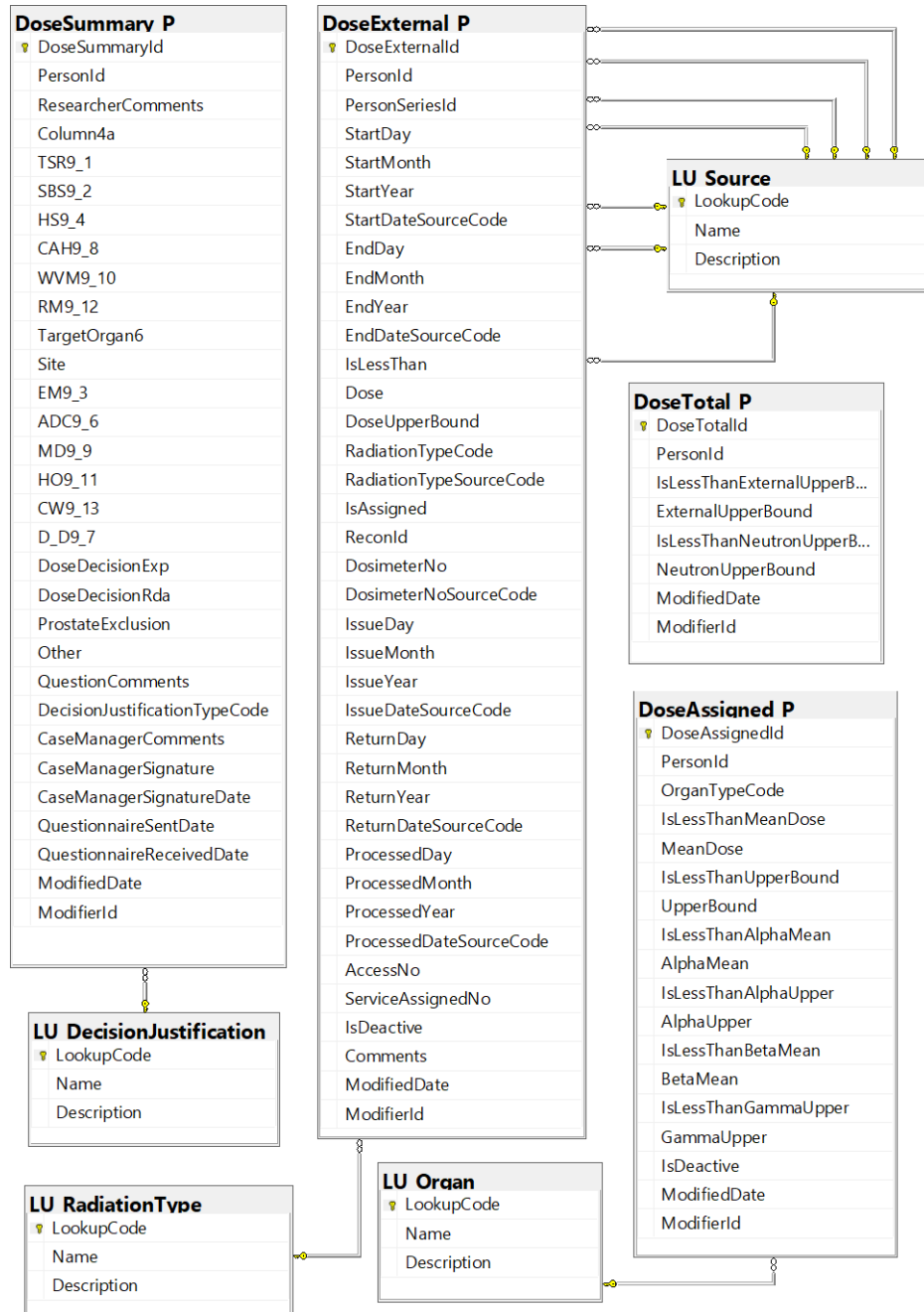


Figure 6: Dose Data Model

11.3 Case Data Model

Figure 7 represents the Case data model and its direct table relationships. The tables contain general information about the veteran’s case. In NuTRIS-Web, this information is entered when a new case is created for a veteran.

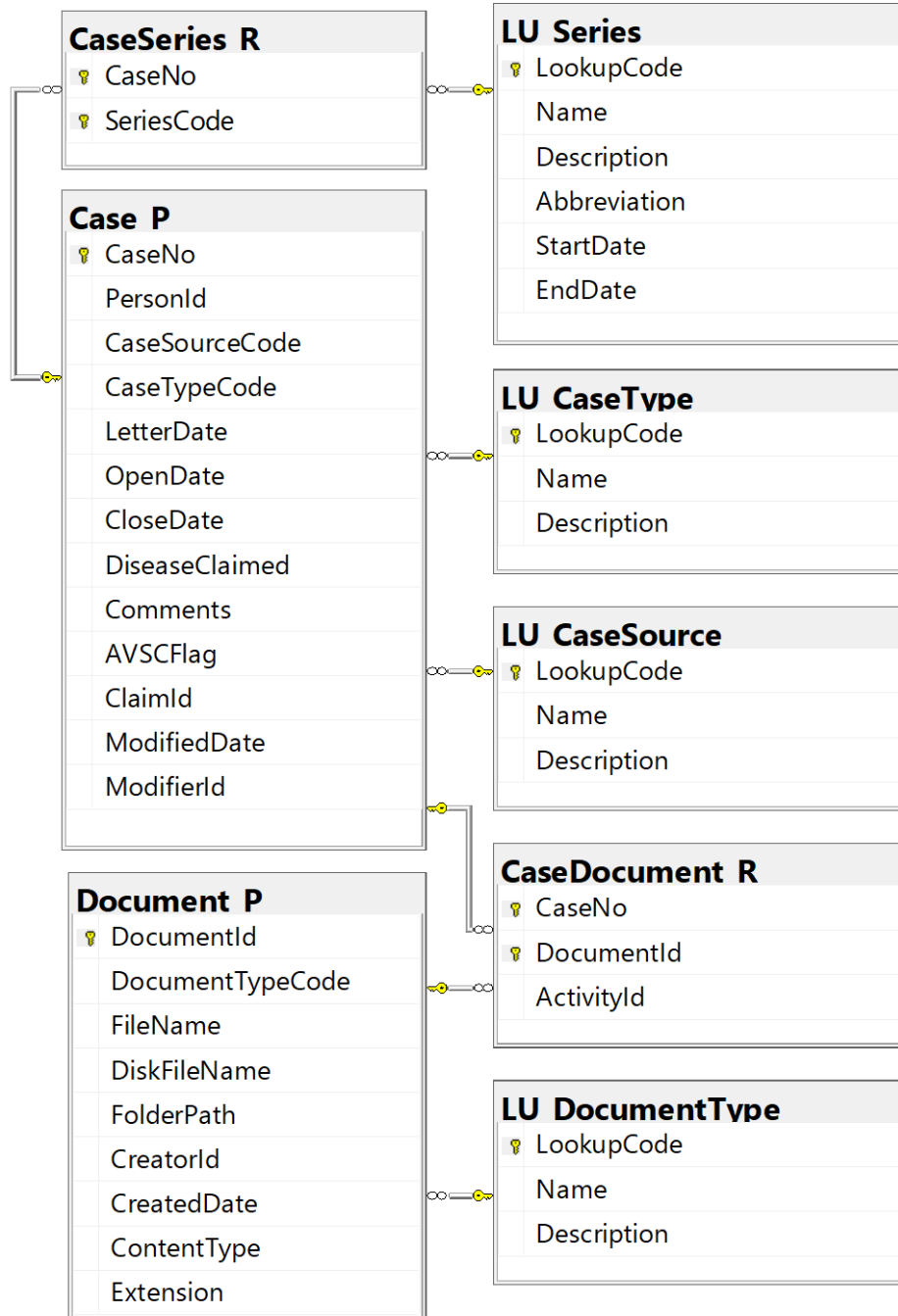


Figure 7: Case Data Model

11.4 Service Data Model

Figure 8 represents the Service data model and its direct table relationships. This table captures the service, series, and unit information for the veteran.

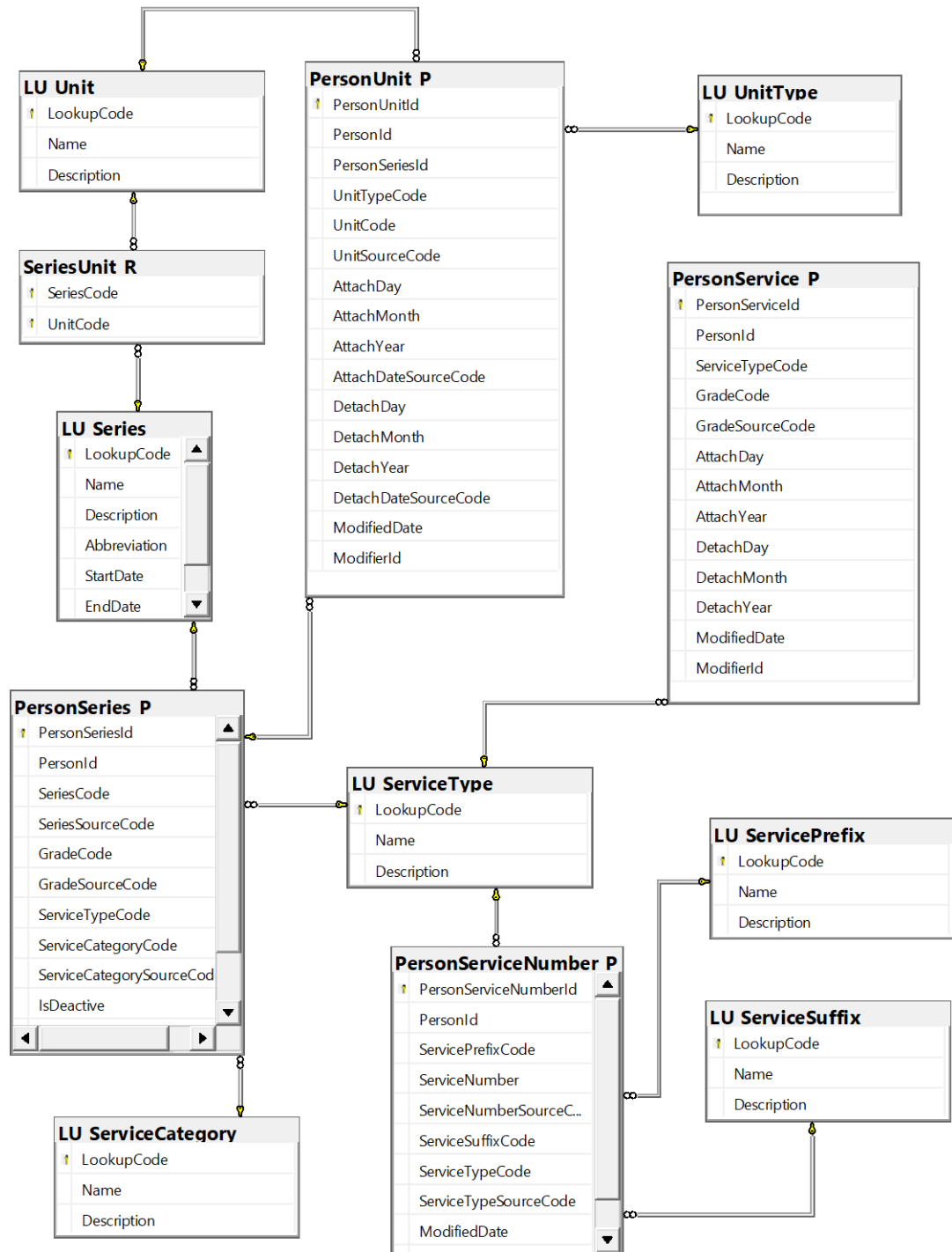


Figure 8: Service Data Model

11.5 Workflow Data Model

Figure 9 represents the Workflow data model and its direct table relationships. The workflow tracks case actions within NuTRIS-Web through workflow phase transitioning, case activities, and tasks.

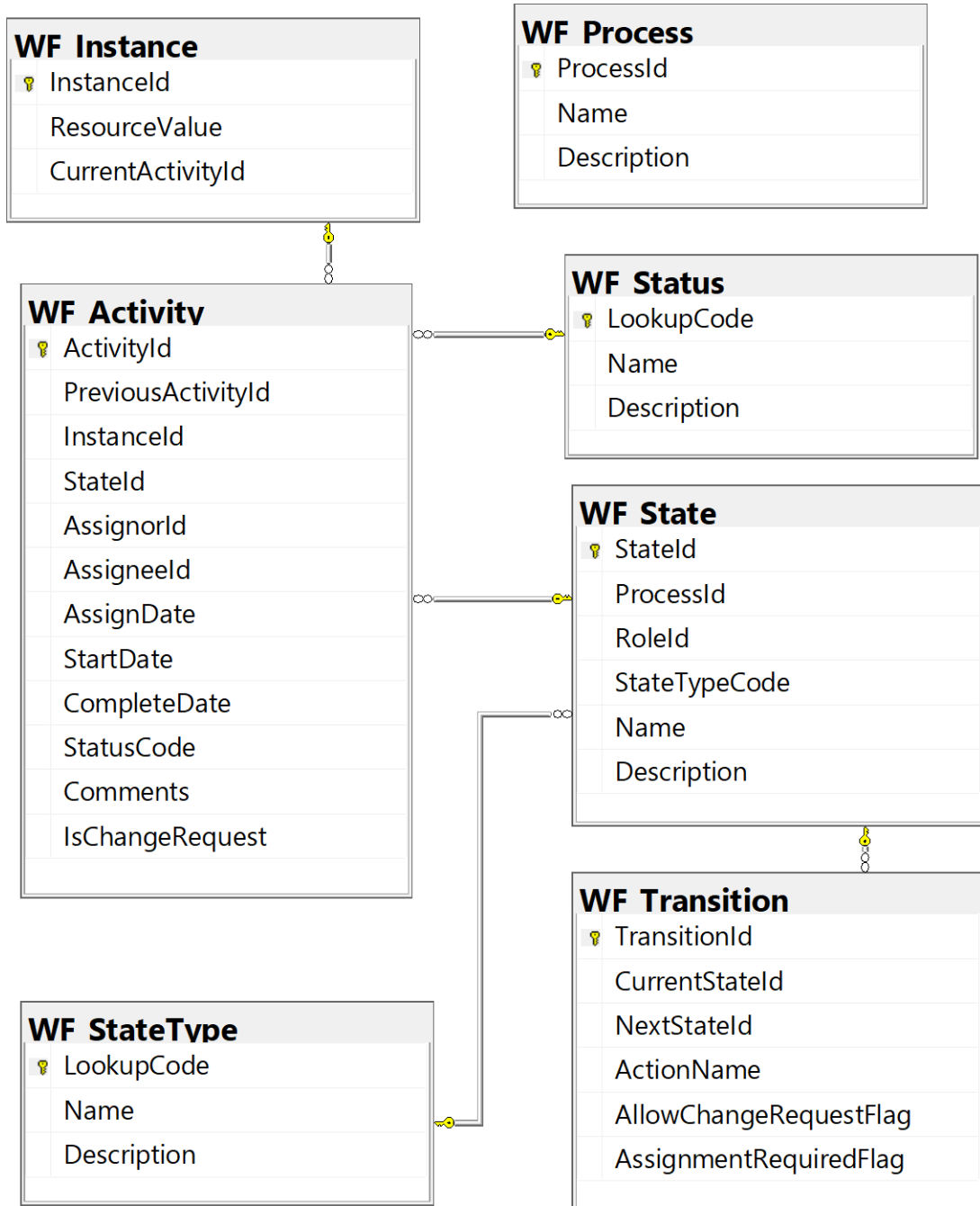


Figure 9: Workflow Data Model

11.6 Legacy Data Model

Figure 10 represents the Legacy data model and its direct table relationships. The tables hold data from the legacy NuTRIS PowerBuilder application and contains historical case information for the veteran.

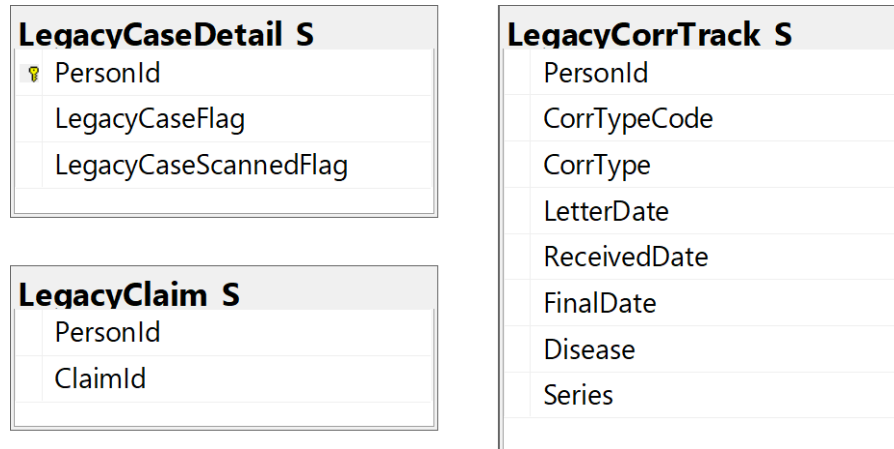


Figure 10: Legacy Data Model

11.7 User Data Model

Figure 11 represents the User data model which contains user role assignments. Access to various functions on NuTRIS-Web are controlled by the roles.

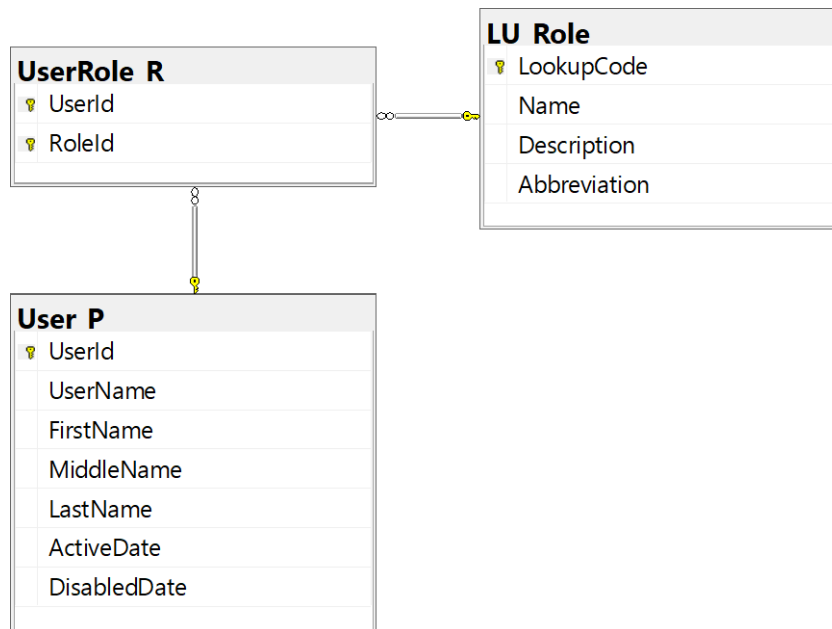


Figure 11: User Data Model

11.8 NPRC

Figure 12 represents the NPRC data model and its direct relationship tables. Information related to NPRC records ordering process will be captured and stored in this data model. Researchers and Records Analyst roles are the primary users of this module.

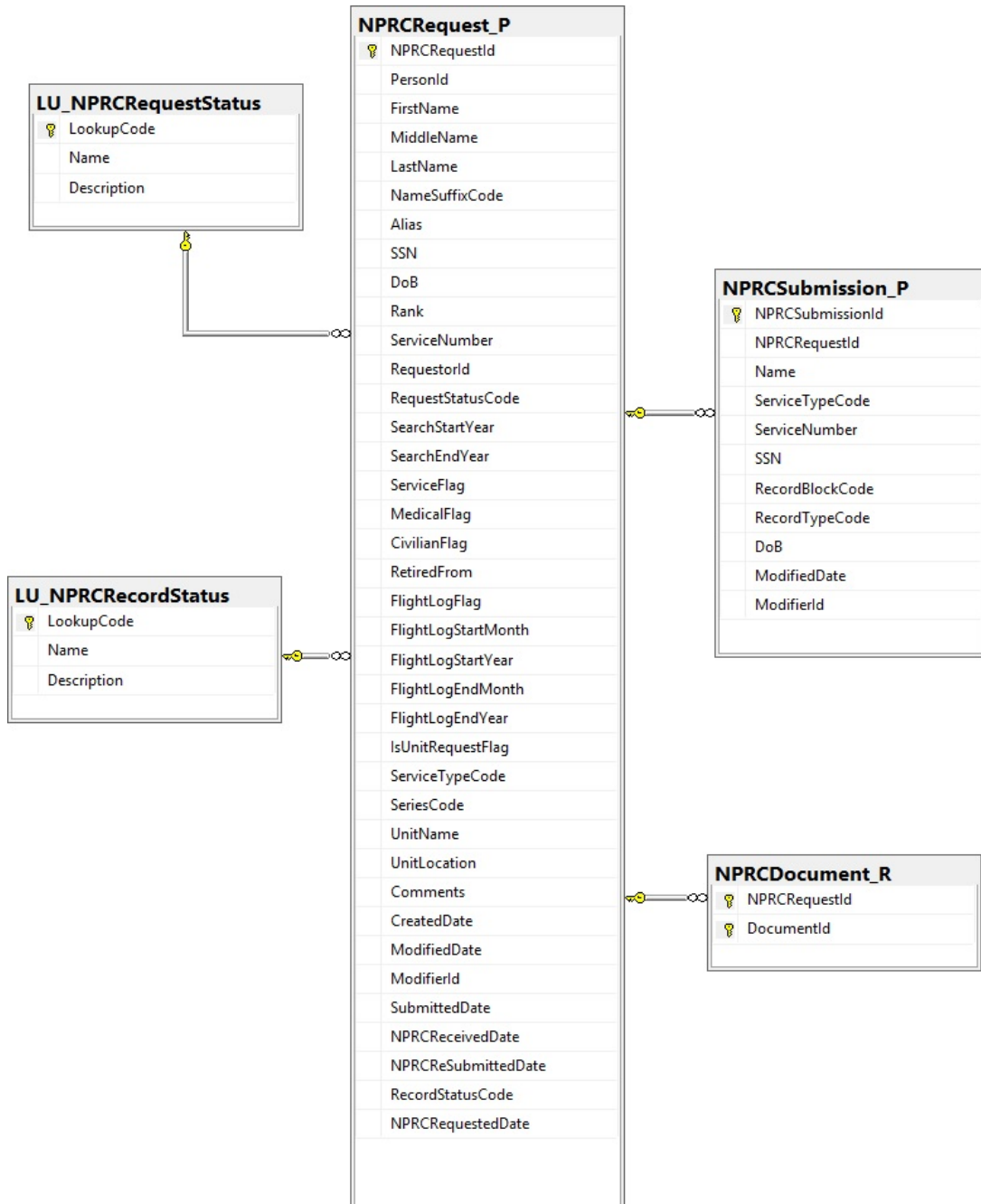


Figure 12: NPRC Data Model

11.9 Outreach

Figure 13 represents the Outreach data model and its direct relationship tables. The tables in the data model contains all the data related to the communication between NTPR staff and Veterans, their beneficiaries, or government agencies and entities involved in the claim.

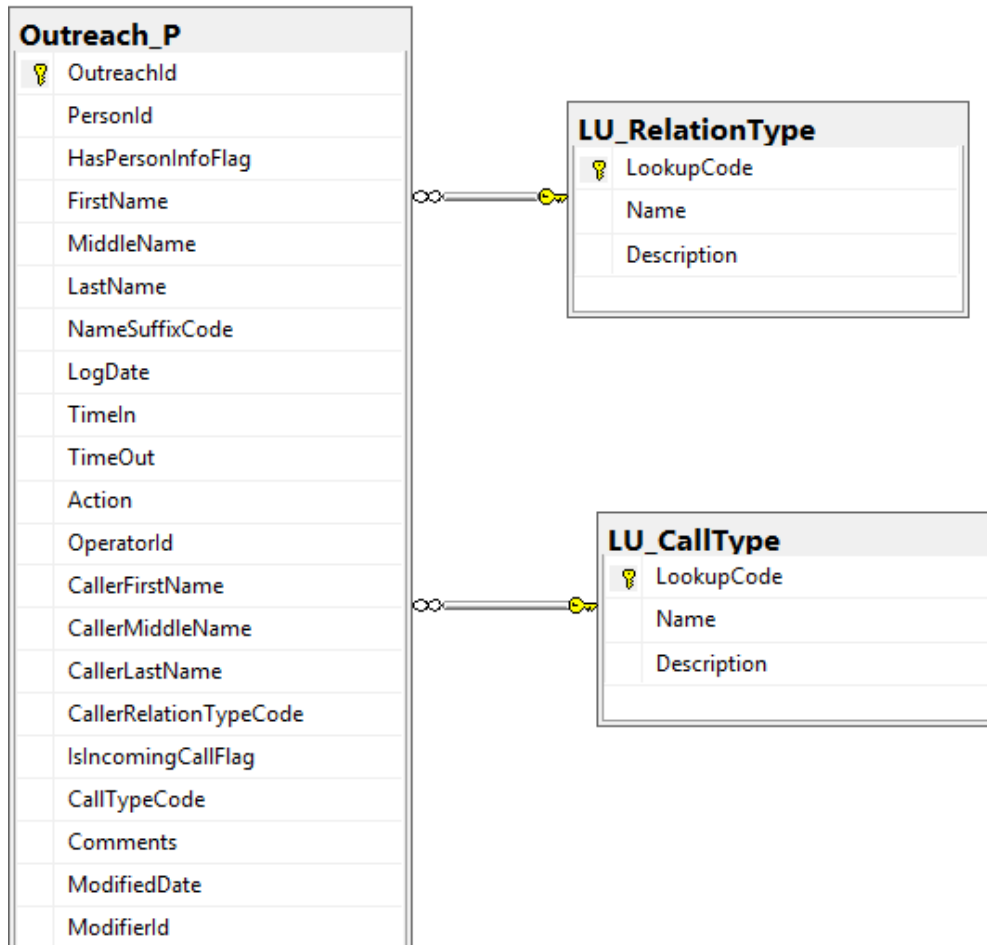


Figure 13: Outreach Data Model

11.10 Outreach AVSC

Figure 14 represents the Outreach AVSC data model and its direct relationship tables. All the AVSC related outreach activities are tracked in this module and the associated data is stored in the tables within this data model.

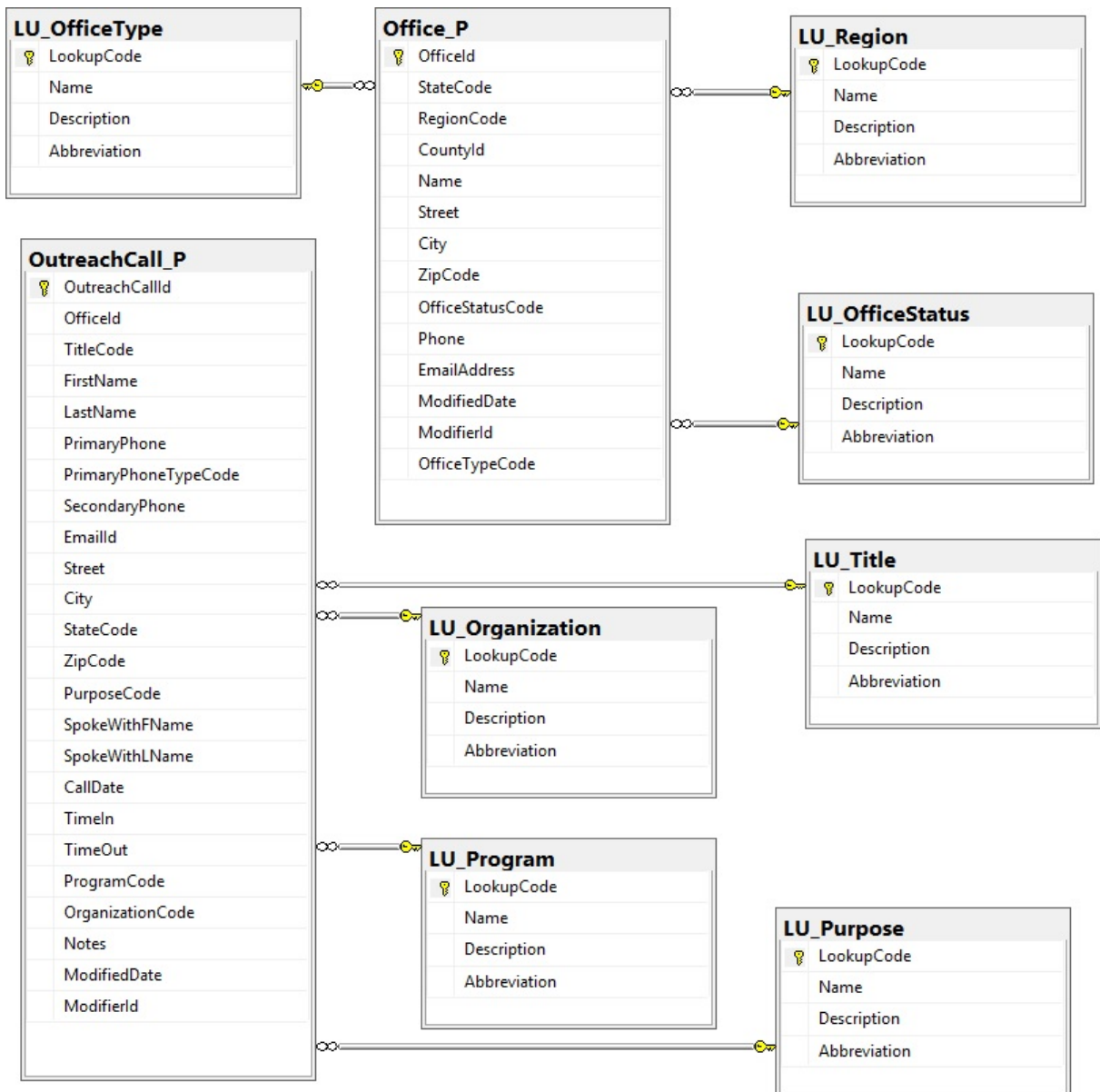


Figure 14: Outreach AVSC Data Model

Section 12. Abbreviations, Acronyms and Symbols

Table 6: Acronyms List

Term	Definition
API	Application Programming Interface
CIC	Coordination and Information Center
CLR	Common Language Runtime
DA	Document Administrator
DDD	Domain Driven Design
DI	Dependency Inversion
DRY	Do not Repeat Yourself
ECUP	Enewetak Cleanup
EF	Entity Framework
HTTPS	Hyper Text Transfer Protocol Secure
MVC	Model View Controller
NPRC	National Personnel Records Center
NTPR	Nuclear Test Personnel Review
NuTRIS	Nuclear Test Research Information System
OLTP	Online Transactional Processing
PI	Persistence Ignorance
POCO	Plain Old CLR Object
RA	Records Analyst
SOA	Service-Oriented Architecture
SQL	Structured Query Language
SSL	Secure Sockets Layer
UI	User Interface
URL	Uniform Resource Locator

Section 13. References

- Dykstra, T., Ross, C., Halter, S., & Smith, S. (2019, November 7). *Web server implementations in ASP.NET Core*. Microsoft Docs. Retrieved September 17, 2021, from <https://docs.microsoft.com/en-us/aspnet/core/fundamentals/servers>.
- Wikimedia Foundation. (2021, September 1). *Dependency inversion principle*. Wikipedia. Retrieved September 17, 2021, from https://en.wikipedia.org/wiki/Dependency_inversion_principle.

Appendix A. User Interface Design

NuTRIS-Web user interface is designed and developed according to the following standards:

1. All NuTRIS-Web functional modules, processes, and features currently in production shall be captured in detailed requirements that can be traced to the new user interface features. These requirements are created as stories in the agile process and maintained in JIRA.
2. Web pages will meet the following guidelines:
 - Proper markup to identify the page title (i.e. an <h1> element)
 - Meaningful titles on all pages
 - Providing alternate text equivalents for images and image map hot spots
 - Providing null text equivalents on decorative images
 - Identifying row and column headers for data tables
 - Programmatically associating labels with form fields
 - Providing indicator to show important information or required fields
 - Alerting users with timed responses
 - Supporting browser settings for enlarging text and user style sheets
 - Using consistent navigation mechanisms and style of presentation throughout the site
 - Supporting keyboard navigation of web pages
 - Testing for compatibility with assistive technology in pages that use JavaScript for essential functions
 - Ensuring accessibility of non-HTML content such as PDF files, Microsoft Word documents, and PowerPoint presentations

Appendix B. Engineering Guidelines

NuTRIS-Web uses the standard engineering guidelines provided by Microsoft:

<https://github.com/aspnet/AspNetCore/wiki/Engineering-guidelines>

Appendix C. Release Notes

NuTRIS Web - Version 1.3.0 (April 30, 2020)

Issue Number	Details
NW-106	Adding/Editing Case: Removed validation on Letter Date
NW-289	Drop-downs now display in alphabetical order
NW-291	Add Person: Display I, II, III, JR, for suffix instead of description
NW-350	Fixed typo for Document Type error message when uploading a document
NW-357	Fixed the display of 0 and 1 for Service Number & Service Suffix after creating a new person
NW-361	Fixed Case Activity header typos
NW-363	Assigning during initial processing is now showing the correct name of person who assigned case
NW-377	Fixed the ability to clear out Dose Summary Questions - Questionnaire Sent and Received Dates
NW-378	Document Management: User can now upload files that are greater than 30MB (Maximum file size upload is < 100 MB)
NW-401	Provide ability to clear search for Case Activity and Personnel Management List Pages
NW-407	Case List Page: Provide ability to sort and filter list
NW-417	Delete File: Add file name to the delete confirmation message to verify the correct file is deleted
NW-420	Case List Navigation: Need to return to sorted or filtered view after clicking Back to List button
NW-428	When tabbing through fields highlight entire field so data can be easily cleared and edited
NW-442	Highlight next field when using tab
NW-451	Update Boiler Type values for Service Rank Rate Descriptions
NW-460	Service Subcategory needs to display description instead of code
NW-462	If a Death date exists for a Person, it should be displayed first in the list (before Birth date)
NW-468	New Document Management: Sort and Filter Files
NW-469	New Document Management: Upload files
NW-470	New Document Management: Delete Files
NW-471	When viewing a case for a person, provide the ability to view the total number of associated cases
NW-472	New Document Management: View Document List
NW-473	Remove document management list and upload feature from the Case Details page
NW-475	Personnel Management List Page: Provide ability to sort and filter list

NuTRIS Web - Version 1.3.1 (May 12, 2020)

Issue Number	Details
NW-483	Removed the scroll bar from the Documents Management list table so that 20 records now display at a time.
NW-484	Users can now delete the files they uploaded at any time.
NW-485	Removed the Document Management functionality from the Case Activity module. Document Management is now only available in the Personnel Management module.

NuTRIS-Web Version 1.3.2 (May 28, 2020)

Issue Number	Details
NW-486	The System Administrator and Research Manager roles can now delete all files in the document list.
NW-487	Changed the document list default sort order to display the Document Type Name in alphabetical order.

NuTRIS-Web Version 2.0.0 (July 16, 2020)

Issue Number	Details
NW-30 NW-32 NW-35 NW-413 NW-492 NW-497 NW-498 NW-500 NW-509 NW-521	<p>Deploys the NPRC Records Request Module:</p> <ul style="list-style-type: none"> • Users can now create NPRC requests in NuTRIS-Web. Features include: • Easy navigation to the NPRC module • Providing users the ability to create NPRC Personnel and Unit requests • Providing Research Managers, Researchers, and Records Analysts the ability to edit NPRC requests • Providing Research Managers, Researchers, and Records Analysts the ability to delete NPRC requests • Searching for NPRC requests by Person ID • Displaying a list of all NPRC requests • Displaying a list of NPRC requests for a Person • Ability to sort the list of NPRC requests • Validations for Flight Log Search Dates when creating or editing NPRC requests • Providing users with a read-only view of NPRC request details
NW-77	Users can now set a flag to identify high priority cases. All high priority cases will be highlighted in yellow on the Case Activity data table and displayed at the top. Non-high priority cases will continue to be sorted by Open Date in ascending order.

NW-506	“Back to List” & ”Back to Person Details” buttons were added to the Personnel Management – Documents tab.
NW-512	Added “Case Type” to the Case Activity data table. This will help users to quickly identify HEC, Presumptive, and Non-Presumptive cases.
NW-228	Added a comma in between the Last Name and First Name in Case Activity data table.
NW-352	Fixed issue where a service record could be saved without entering the required field "Service".
NW-359	Fixed issue where the “Back to List” button was displaying in the Personnel Management tabs instead of “Back to Person Details”.
NW-527	Fixed issue where the Case Activity table was not returning to the default sort when “Clear All Filters” button was clicked.

NuTRIS-Web Version 2.1.0 (October 29, 2020)

Issue Number	Details
NW-34	Provided the ability to search for Unit and Personnel NPRC requests.
NW-392	Provided the ability for the Records Analyst to View the NPRC submission table.
NW-496	Disabled fields based on the type of NPRC request: Unit or Personnel
NW-505	First Name and Last name are required for NPRC personnel requests.
NW-516	Added SSN validations to the Create/Edit NPRC request.
NW-517	Added Search Date validations to the Create/Edit NPRC request.
NW-518	Added Unit validations to the Create/Edit NPRC request.
NW-528	Enhanced the NPRC search to include additional search criteria fields.
NW-548	Provided the ability for the Records Analyst to Print the NPRC submission table.
NW-550	Provided the ability to only view Personnel NPRC requests within the Records tab.
NW-554	Provided the ability for the Records Analyst to Add a new record (blank row) to the NPRC submission table.
NW-555	Provided the ability for the Records Analyst to Delete a record in the NPRC submission table.
NW-557	Provided the ability for the Records Analyst to Edit a record in the NPRC submission table.
NW-558	Provided the ability to only view Unit NPRC requests within the Records tab.
NW-560	Provided the ability for the Records Analyst to select NPRC requests to include in the NPRC submission.
NW-565	Added validations to the fields in the NPRC submission table.
NW-572	Updated the Research tab to only display NPRC requests that have been created or completed.
NW-573	Updated the Records tab to only display NPRC requests that have been submitted or in progress.
NW-574	Provided the ability for Research Analysts and Research Managers to submit NPRC Requests to the Records Analyst.

NW-578	Provided the ability for the Records Analyst to edit NPRC dates and statuses for a request.
NW-585	Added person header details to the NPRC Request Action page.
NW-586	Added a save confirmation when the Records Analyst saves the NPRC Request Action page.
NW-587	Provided the ability for the Records Analyst to submit a completed NPRC request back to the Research team.
NW-588	Provided the ability for the Records Analyst to print the Personnel and Unit tables within the Records tab.
NW-605	Provided the ability for the Records Analyst to Delete all the records at once from the NPRC submission table.

NuTRIS-Web - Version 2.2.0 (January 22, 2021)

Issue Number	Details
NW-71	Adds the ability to modify an existing Outreach record from the Outreach Page.
NW-72	Adds the Outreach Page to the NuTRIS-Web application.
NW-365	Adds the ability to create a new Outreach record from the Outreach Page.
NW-366	Adds the ability to access the new Outreach Page.
NW-433	Adds the ability to delete an existing Outreach record from the Outreach Page.
NW-434	Migrates legacy Outreach records to the NuTRIS-Web application.

NuTRIS-Web Version 2.3.0 (April 30, 2021)

Issue Number	Details
NW-625 NW-626 NW-627 NW-628 NW-629	<p>Users can now create AVSC Offices in the Outreach section of NuTRIS-Web. Features include:</p> <ul style="list-style-type: none"> • Easy navigation to the AVSC Office module • Display a list of AVSC Offices. • Search for, and display AVSC Offices by any combination of State, Region, and County. • Providing Case Managers and Case Administrators the ability to add AVSC Offices. • Providing Case Managers and Case Administrators the ability to modify AVSC Offices. • Providing Case Managers and Case Administrators the ability to delete AVSC Offices. • Ability to sort the list of AVSC Offices. • Ability to filter the list of AVSC Offices.
NW-638 NW-639 NW-640 NW-641	<p>Users can now create an AVSC Call log in the Outreach section of NuTRIS-Web. Features include:</p> <ul style="list-style-type: none"> • Easy navigation to the AVSC Call Log module • Display a list of AVSC Calls.

NW-642	<ul style="list-style-type: none"> • Display AVSC Calls for any AVSC Office. • Providing Case Managers and Case Administrators the ability to add AVSC Calls. • Providing Case Managers and Case Administrators the ability to modify AVSC Calls. • Providing Case Managers and Case Administrators the ability to delete AVSC Calls. • Ability to sort the list of AVSC Calls. • Ability to filter the list of AVSC Calls.
NW-662	Fixed the issue where the Current Task Filter on the Case Activity Screen was not working for the value “Review Research”.

NuTRIS-Web Version 2.4.0 (July 23, 2021)

Issue Number	Details
NW-446	<p>Created a new user role named “Document Administrator”. The new user role allows the user to:</p> <ul style="list-style-type: none"> • Delete file documents. • Modify file documents.
NW-671	<p>Users can now change the name of files that have been previously unloaded to NuTRIS-Web. Features include:</p> <ul style="list-style-type: none"> • Ability to change the file name. • The file extension cannot be changed. • The new file name cannot be empty or cannot contain a period (.) character.
NW-673	<p>Added a new dropdown field named "Office Type" to Outreach AVSC Office records. The available values are:</p> <ul style="list-style-type: none"> • City • County • State • Congressional • Senatorial • Assembly • State Senate
NW-676 NW-677 NW-679	<p>Users can now access ECUP and Island Access Legacy Data in the Supplemental Data section of NuTRIS-Web. Features include:</p> <ul style="list-style-type: none"> • Easy navigation to the ECUP module. • Display a list of the ECUP data. • Search for, and display ECUP data by SSN, First Name, or Last Name. • Ability to sort the list of ECUP data. • Ability to filter the list of ECUP data. • The ECUP data is read-only and cannot be modified by the users. • Easy navigation to the Island Access module.

Issue Number	Details
	<ul style="list-style-type: none"> • Display a list of the Island Access data. • Search for, and display Island Access data by SSN, First Name, or Last Name. • Ability to sort the list of Island Access data. • Ability to filter the list of Island Access data. • The Island Access data is read-only and cannot be modified by the users.
NW-680 NW-681	<p>Users can now access Bechtel Legacy Data in the Supplemental Data section of NuTRIS-Web. Features include:</p> <ul style="list-style-type: none"> • Easy navigation to the Bechtel module. • Display a list of the Bechtel data. • Search for, and display Bechtel data by Account Number, SSN, First Name, or Last Name. • Ability to sort the list of Bechtel data. • Ability to filter the list of Bechtel data. • The Bechtel data is read-only and cannot be modified by the users. • Easy navigation to the Island Access module.
NW-682	<p>Added the ability to display the suffix in all instances of the Veteran Name. The suffix has been added to the following locations:</p> <ul style="list-style-type: none"> • The Person Name column in case list page. • A new Suffix column has in the person list under Personnel Management. • The shared view in Search Personnel Details. • A new Suffix column in the NPRC (Research) list. • A new Suffix column in the NPRC (Records) list. • The name field under NPRC (Record) item detail.
NW-674	Fixed several typographical errors in county names in the AVSC Office Module.
NW-675	Fixed a trailing space issue for all county names in the AVSC Office Module.
NW-678	Fixed the issue where Outreach records were not being found/displayed when the Log Date is Null.

NuTRIS-Web Version 2.4.1 (August 13, 2021)

Issue Number	Details
NW-704	Limited the initial number of records displayed on the Bechtel List Page to Veterans with active cases. Matching to Active Cases is performed using the SSN of the Veteran. If an SSN doesn't exist in the Bechtel data, the record is not displayed by default. Any Bechtel records that do not contain an SSN can still be found via a Name search.
NW-706	Limited the initial number of records displayed on the ECUP List Page to Veterans with active cases. Matching to Active Cases is performed using the SSN of the Veteran. If an SSN doesn't exist in the ECUP data, the record is

Issue Number	Details
	not displayed by default. Any ECUP records that do not contain an SSN can still be found via a Name search.
NW-707	Limited the initial number of records displayed on the ECUP Island Access List Page to Veterans with active cases. Matching to Active Cases is performed using the SSN of the Veteran. If an SSN doesn't exist in the ECUP Island Access data, the record is not displayed by default. Any ECUP Island Access records that do not contain an SSN can still be found via a Name search.
NW-705	Fixed the Browser sizing issue, where the NuTRIS Web Application was not being displayed properly.
NW-708	Fixed the issue where the Back Button was not working on the ECUP and Bechtel List Pages.
NW-709	Fixed the issue where all the records resulting from a Name search were not being returned, on the ECUP and Bechtel List Pages.

NuTRIS-Web Version 2.5.0 (August 30, 2021)

Issue Number	Details
NW-689 NW-690	Users can now access Issue Card Data in the Supplemental Data section of NuTRIS-Web. Features include: <ul style="list-style-type: none"> • Easy navigation to the Issue Card module. • Display a list of the Issue Card data. • Search for Issue Card data by First Name and/or Last Name. • Ability to sort the list of Issue Card data. • Ability to filter the list of Issue Card data. • The Issue Card data is read-only and cannot be modified by the users. • Easy navigation to the detailed Issue Card data.
NW-693 NW-694	Users can now access a hybrid CIC Report in the Supplemental Data section of NuTRIS-Web. Features include: <ul style="list-style-type: none"> • Easy navigation to the CIC module. • Display a list of the CIC data. • Search for, and display CIC data by Name, From Date, To Date, or Title. • Ability to sort the list of CIC data. • Ability to filter the list of CIC data. • The CIC data is read-only and cannot be modified by the users.