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Guidelines for Preparation of
CPM Schedule
Volume I

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1. INTRODUCTION

1.1. Purpose and Scope

This document is intended to provide guidance to the Architect/Engineer (A/E) in the development of the Integrated Project Master Schedule (IPMS) and Detailed Design Schedule during the design phase of Medical Center Major New Facilities, Additions and Renovations projects by the United States Veterans Affairs (VA). The VA oversees complex projects throughout the country which require careful planning and execution during the evolution of the projects.

The purpose of the Integrated Project Master Schedule (IPMS) is to determine the number of days that is reasonable to complete the design, construction and activation phases of the project. It also provides a useful road map that can be used by the A/E and the project team to assist them in completing the project successfully.

The IPMS is intended to be a dynamic tool for project control and Earned Value Management (EVM), developed by the A/E with input from all parties involved including the Office of Construction and Facilities Management (CFM) Project Manager, the Department of Veterans Affairs Medical Center (VAMC) Director and Facility Engineer, Veterans' Integrated Service Network (VISN) Capital Asset Manager, VA CAMPS Office, the Office of Strategic Management and Contracting Officer and Peer Reviewers. The IPMS may be used as a reference by the Construction staff as it also encompasses high level activities in the procurement, construction and activation phases.

The VA executes projects using three project delivery methods: Design-Bid-Build, Design-Build and Integrated Design-Build. In Design-Bid-Build, the VA awards a single construction contract to a General Contractor after the design is complete. In Design-Build, the A/E and the Contractor are brought together as a single point of delivery/management. In Integrated Design-Build, the VA contracts a Construction Manager (CM) early to participate in parallel with the A/E in pre-construction activities and manage the overall program from design through activation.

The level of detail of the IPMS that the A/E has to produce during a VAMC project is contingent on the project delivery method. This guideline is written primarily for the Design-Bid-Build Project Delivery System. It could also be applicable to the Integrated Project Delivery System.

It is recognized that several scheduling methods exist and these methods may produce fully acceptable results. It is not the intent of this document to discredit other methods or to discourage creativity and flexibility. Rather, it is the intent of this document to provide

the A/E with a set of approaches, techniques and methods that have been proven over time as acceptable.

It is also recognized that these guidelines cannot cover every situation one may encounter when creating schedules, reviewing schedules or analyzing changes or delays. These guidelines may serve as a starting point for analyzing these unique situations.

This document is solely intended as a guide, it is not intended to dictate means and methods. The A/E is responsible to develop the means and methods and correlate with the VA requirements.

1.2. Applicable Documents

A baseline set of governing documents to be applied on developing the CPM Scheduling Guideline is listed in the following table (Table 1).

Document Title	Document Location
PG 18-15 A/E Submission Requirements for VA Medical Center Major New Facilities, Additions and Renovations.	http://www.cfm.va.gov/contract/ae/aesubmai/
Design Manual for CPM Schedule & Risk Management for Architect/Engineers (A/E), Department of Veterans Affairs. December 2012.	http://www.cfm.va.gov/til/dManual/
Architectural and Engineering CPM schedules. Section 01 32 16.01.	http://www.cfm.va.gov/til/spec/
A Guide to the Project Management Body of Knowledge (PMBOK® Guide).	Refer to http://www.pmi.org/
The Associated General Contractors of America, Construction Planning and Scheduling (2 nd Edition).	
PMI Practice Standard for Scheduling.	Refer to http://www.pmi.org/

Table 1

1.3. Definitions and Abbreviations

Activity or Event:	A discrete, identifiable task or event that takes time, has a definable start and stop date, furthers the work's progress, and can be used to plan, schedule and monitor a project.
Activity, Controlling:	The first incomplete activity on the critical path (Also referred to as the controlling operation).
Activity, Critical:	Any activity on the critical path.
Activity ID:	A unique, alphanumeric, identification code assigned to an activity.
Activity Network Diagram:	(Also called a pure-logic diagram) A graphic representation of a CPM schedule that shows the relationships among activities.
A/E:	Architect/Engineer.
Bar Chart:	(Also called a Gantt chart) A graphical representation of a schedule without relationships. A timescale appears along the horizontal axis.
Calendar Day:	A day on the calendar, beginning and ending at midnight.
Completion Date, Contract:	The original date specified in the contract for completion of the project or a revised date resulting from authorized time extensions. The contract may also specify completion dates for interim milestones, phases, or other portions of the project.
Completion Date, Scheduled:	The completion date projected or forecasted by the schedule. The schedule may also project or forecast interim completion dates for milestones, phases, or other portions of the project.
Constraint:	A restriction imposed on the start or finish dates of an activity that modifies or overrides the activity's logic relationships.
Critical Path:	The Longest Path through the project network that determines the project duration.
Critical Path Method (CPM):	A network analysis technique used to predict duration by analyzing which sequence of activities (which path) has the least

amount of scheduling flexibility (least amount of float). Early dates are calculated by means of a forward pass using a specified start date. Late dates are calculated by means of a backward pass starting from a specified completion date (usually the forward pass's calculated project early finish date).

Data Date: The first day in the initial or baseline schedule and the first day for performance of the work remaining in the Monthly Schedule Update or Revised Schedule. (May also be defined as the date from which a schedule is calculated).

Duration, Original: The estimated time, expressed in workdays, needed to perform an activity.

Duration, Remaining: The estimated time, expressed in workdays, needed to complete an activity.

Float, Free: The amount of time an activity can be delayed and not delay its successor(s).

Float, Total: The amount of time an activity can be delayed and not delay the project completion date.

Fragnet A breakdown of an activity into a number of smaller activities that provide greater detail for the planning, scheduling, monitoring, and controlling the larger activity.

Holidays: Holidays observed by the United States Government are:

- 1st day in January (New Year's Day)
- 3rd Monday in January (Martin Luther King, Jr. Day)
- 3rd Monday in February (President's Day)
- Last Monday in May (Memorial Day)
- 4th day in July (Independence Day)
- 1st Monday in September (Labor Day)
- 2nd week in October (Columbus Day)
- 11th Day in November (Veterans Day)
- 4th Thursday in November (Thanksgiving Day)
- 25th Day in December (Christmas Day)

For holidays that fall on a Saturday, both the Saturday and preceding Friday are considered to be holidays. For holidays that fall on a Sunday, both the Sunday and following Monday are

considered to be a holiday.

Longest Path:	The longest continuous sequence of activities that establishes the scheduled completion date.
Milestone:	An activity/event, with no duration, that is typically used to represent the beginning or end of the project or its interim stages.
Narrative Report:	A descriptive report submitted with each schedule. The required contents of this report are set forth in a scheduling specification.
Open End:	The condition that exists when an activity has either no predecessor or no successor, or when an activity's only predecessor relationship is a finish-to-finish relationship or only successor relationship is a start-to-start relationship.
Predecessor:	An activity that is defined by schedule logic to precede another activity. A predecessor may control the start or finish date of its successor.
Relationship:	The interdependence among activities. Relationships link an activity to its predecessors and successors. (A schedule's relationships are sometimes referred to as the logic of the schedule. Examples of relationships are: finish-to-start, start-to-start, and finish-to-finish).
Relationships between Activities:	- Finish to Start - The successor activity can begin only when the predecessor completes. - Finish to Finish - The finish of the successor activity depends on the finish of the predecessor. - Start to Start - The start of the successor activity depends on the start of the predecessor. - Start to Finish - The successor activity cannot finish until the current activity starts.
Schedule:	A group of activities interconnected by relationships to depict the plan for execution of a project, usually shown by calendar dates.
Schedule, Baseline:	The accepted schedule showing the original plan to complete the entire project. (Sometimes known as the as-planned schedule).
Successor:	An activity that is defined by schedule logic to succeed another activity. The start or finish date of a successor may be controlled

by its predecessor.

TIL: VA Technical Information Library.

Work Breakdown Structure (WBS): A deliverable-oriented grouping of project elements, which organizes and defines the total scope of a project. Each descending level represents an increasingly detailed definition of a project component. A logical breakdown of project hierarchy or structure.

Working Schedule: A schedule utilized for duration of a project for creation of the baseline schedule and updates.

Work Package: A deliverable at the lowest level of the work breakdown structure. Work package contains activities.

2. SCHEDULING METHOD

2.1. Introduction

Scheduling methods provide the framework within which schedule models are developed. Critical Path Method (CPM) is the VA's chosen methodology for developing project schedules.

In accordance with PG 18-15, the Architect/Engineer (A/E) shall furnish and maintain an Integrated Project Master Schedule (IPMS) utilizing a computer based network analysis scheduling software. The IPMS shall be prepared using the precedence diagramming method (PDM) and shall depict the major phases of the project. The IPMS will provide a summary level schedule for the Procurement, Construction, and Activation phases of the project. The A/E will expand the level of detail for the Design Phase to show in detail how the A/E plans to execute the design.

The A/E shall develop a logic-based network of design activities with empirically derived durations for execution in a realistic and practical manner, in order to establish a meaningful critical path. There must not be any open ends other than the project start and finish milestones. Constraints must be restricted to those that represent external or internal conditions that cannot be feasibly accomplished with activity logic.

The A/E shall also identify and assign resources to the design schedule activities.

2.2. Scheduling Software

The A/E shall propose to the VA, a scheduling tool that is capable of assembling the schedule model and providing the means of adjusting various parameters and components that are typical in a modeling process. It shall be capable of producing the reports required by the VA contract documents. The proposed scheduling tool shall have the capability to:

- Select the type of relationship (such as finish-to-start or finish-to-finish)
- Add lags between activities (applied only on an exception basis)
- Apply resources and use that information along with resource availability to adjust the scheduling of activities
- Add start and finish constraints
- Capture a specific schedule as a baseline or target schedule
- Compare the most recent schedule against the previous one or against a target or baseline to identify and quantify trends or variances
- Define longest path activities

2.3. Assumptions

During development of the IPMS, the A/E shall identify any necessary assumptions and document those assumptions properly. Typical assumptions for a VAMC project may include:

- Normal workday involves an 8-hour shift, Monday through Friday excluding major holidays.
- Allow 45 Calendar Days after receipt of NTP for the A/E to submit a complete CPM Schedule.
- Value Engineering occurs at the end of submission milestones.
- The final CPM schedule in its original form shall contain no contract modifications or changes which may have been incurred during the final CPM schedule development period and shall reflect the entire contract duration as defined in the bid documents.
- All permits will be obtained prior to the Notice-To-Proceed.
- The VA Medical Center will provide input during each phase of the design.
- No single design activity shall exceed 20 work days, except for which the Project Manager and/or the Contracting Officer may approve the showing of a longer duration.
- The A/E will adequately plan his/her work according to the sequence of design provided in the contract documents and prosecute the work in a continuous fashion.

2.4. Scheduling Best Practices

In developing a schedule, at a minimum, the A/E shall adapt the following best practices:

- Clearly define activities supported by specific quantity and scope.
- Provide good logic based on realistic sequence of work agreed by A/E team.
- Do not use negative lags. (See VA NAS Specification).
- Do not use a finish to start relationship with a lag. Instead, an activity must be added to represent actual scope of work.
- A project shall have one beginning and one end except for multiple phased projects. All activities shall have a predecessor and successor except the project's start and finish milestones. No "open ends" will be permitted.
- Durations of work activities shall not exceed the update cycle (20 work days). Longer durations may be used provided there is quantitative means for measuring progress.

- If an activity is a start-to-start relationship- it shall be closed with a finish-to-finish or finish-to-start relationship (No open ends).
- All intermediate milestones (interim completion dates) required for the project shall be shown in the proper logical sequence and input as either the “start-no-earlier-than” or “finish-no-later-than” date. Use of mandatory starts and mandatory finishes is discouraged.

2.5. Risk Analysis

The A/E shall conduct the schedule risk analysis (SRA) based on the detailed design activities, identifying major schedule risk areas and recommended risk mitigation plans.

The risk analysis shall be conducted by a person or firm skilled in developing schedule risk analysis based on the (PDM) CPM schedule techniques for major projects, preferably in the major health care related projects. The cost of this service shall be included in the A/E's proposal.

The Contracting Officer has the right to approve or disapprove the person or firm designated to perform the risk analysis. The risk analysis exercise shall be performed or updated during each design phase as defined in VA PG 18-15 or as directed by the VA Contracting Officer.

According to VA PG 18-15, the A/E shall provide for the VA review and comment, the Risk Management Plan (risk register, recommendations for addressing major risks, mitigation plans, and other related documents) included in the Manual for Preparation of Risk Management Plan for Medical Center Project which is a supplement to this guideline.

As depicted in Table 2 of the RMP, the schedule risk analysis is required over a period of time throughout the different phases (Pre-Design, Schematic Design, Design Development and Construction Documents) of the project.

2.6. Deliverables

VA PG 18-15 requires multiple submissions of the CPM schedule over a period of time that evolves throughout the project. These deliverables are in addition to the monthly schedule updates that the A/E shall submit in accordance with the VA A/E scheduling specification section 01 32 16.01. The below table identifies the phases and the level of detail in which the A/E shall submit the CPM schedules for the VA review and comment:

Design Phase	IPMS Deliverable
Pre-Design	• Anticipated Integrated Project Master Schedule (IPMS) including anticipated duration of each phase of design and construction. • Narrative establishing users' vision, goals, and desired image. • Qualifications for analysis and CPM consultants for approval by VA. • Project risk analysis including Recommendations for mitigation of major risks. • Concise narrative describing integration of existing and new work.
Schematic Design (SD-1)	• Cost loaded Project Master Schedule that identifies major design activities, procurement phase activities and construction phasing sequence with major milestones, and VAMC overlapping activation phase. • Cost Loaded Detailed design schedule identifying major activities, submissions, participants, and milestones including Bid and Award, show activities for each primary design discipline. • Schedule Risk Analysis based on CPM for detailed design and overall construction schedule. • Phasing narrative, plans on reduced site plans and diagram marked on full size drawings for VA review. • Written list of systems divided by technical discipline, including temporary systems by phase.

Table 2

Design Phase	IPMS Deliverable
Schematic Design (SD-2)	• Updated Project Master Schedule and Detailed Design Schedule. • Updated Schedule Risk Analysis. • Phasing narrative, plans on reduced site plans and diagram marked on full size drawings for VA review.
Design Development (DD-1)	• Updated Project Master Schedule and Detailed Design Schedule. • Updated Schedule Risk Analysis. • Updated Phasing narrative, diagram and plans on reduced site plans marked on full drawings for VA review.
Design Development (DD-2)	• Updated Project Master Schedule and Detailed Design Schedule with increased detail. • Updated Schedule Risk Analysis with increased detail in new risks and mitigation plan. • Updated Phasing narrative and Phasing diagram. • Full-size contract drawings for the CPM phasing plans.
Construction Documents (CD-1)	• Updated Project Master Schedule with increased detail. • Updated Schedule Risk Analysis identifying new risks and mitigation actions, particularly in construction areas. • Updated Phasing Narrative and Phasing Diagram. • Full-size contract drawings for the CPM phasing plans.

Table 2 (Continued)

3. GUIDELINE FOR DEVELOPING AN INTEGRATED PROJECT MASTER SCHEDULE (IPMS)

The IPMS is to be a master schedule covering all phases (pre-design, design, procurement, construction and activation) of the current project and integrating other projects within the campus master plan, if applicable. The IPMS is to be prepared in CPM network format. The construction phase is to be a Level 2 schedule while the other phases are to be Level 3 schedules. The A/E shall utilize the IPMS to plan, implement, and effectively control the overall project at a high level.

The development of a CPM schedule to provide management of a typical VAMC project that would follow the specification requirements designated in VA PG 18-15 is a process that involves a series of individual steps, each building upon products of the previous steps and project control. The following are hierarchical steps involved in developing the IPMS.

3.1 Comprehension of the full scope of the project

The A/E shall review and fully understand the project's scope documents. These documents provide the background, information and understanding needed to develop the IPMS. The goal of this process is to ascertain that all aspects of the project scope have been adequately defined and captured in the IPMS.

The A/E shall identify and proactively communicate with the entire project stakeholders, identify all the potential risks involved in each phase of the project, from Pre-Design to Activation. The A/E shall also understand the constraints such as zoning requirements and permitting (environmental).

The IPMS shall depict the complete life cycle of the VA project. A typical VA project life cycle is as follows:

3.1.1 Design

This phase contains the sequence of design activities as detailed in the A/E specifications from Notice-To-Proceed (NTP) to the Design Review Meeting in the Construction Documents (CD1) phase. It also encompasses the minimum submission requirements for the detailed design phase of the Integrated Project Master Schedule (IPMS). This phase captures one conceptual submission, two schematic Design (SD1 and SD2) submissions, two Design Development (DD1 and DD2) submissions and two Construction Documents (CD1 and CD2) submissions. The A/E will be responsible for preparing a detailed design schedule for the project. Refer to Exhibit I.1 depicting a

Level 1 Project Master Schedule. A complete sample of IPMS is available on the VA's Technical Information Library.

3.1.2 Procurement

This phase occurs when a typical VAMC project formally transitions from design preparation into construction mobilization. This phase includes the bidding and award processes. The project's schedule and budget are finalized in this phase. Typical milestone activities included in this phase are in the following sequence:

- Construction Bid Document Printed
- Construction Package Advertised
- Necessary Addenda Issued
- Bids Received and Tabulated
- Analysis of Low Bid and Bidder's Qualifications
- VA Award Construction Contract
- Contractor Furnish Bonds and Insurance
- Contractor Executed and Certified by VA
- Construction Notice To Proceed

3.1.3 Construction

The construction phase presents the actual physical construction of the project. The A/E shall develop a preliminary construction schedule for the purpose of construction phasing and duration. The A/E shall define project constraints, requirements of stakeholders, operation and facility requirements. The A/E shall come up with the construction phasing in collaboration with the VA. The proposed schedule of the construction phase is expected to be a Level 2 schedule in the IPMS. It commences with the issuance of the Construction Notice to Proceed, followed by mobilization of the General Contractor to the site, then the physical construction, commissioning of building systems and finally ends with activities associated with Substantial Completion.

According to VA PG 18-15, during the Pre-Design phase, the A/E in collaboration with the VA and all the project stakeholders shall develop an outline of phasing requirements including anticipated overall construction schedule, considerations that influence phasing, anticipated duration of each phase of construction and a narrative establishing users' vision, goals, and desired image. In this preliminary phase, major milestones for the construction schedule shall be discussed by the project stakeholders.

The A/E shall provide a written narrative to outline phasing requirements and sequence for the construction schedule. The A/E shall justify the phasing and construction

duration suggested. The phasing shall be supported by enough details including trade activities, long lead items and VAMC operational requirements.

All areas of the project included in Construction shall be identified as part of a phase. Each phase description shall include constraints particular to that phase, what other phases must precede it, other contractors working in that phase, and any VA moves/relocation which must precede the start of the phase or phases. If equipment and other removable items require storage and relocation by the VA, these requirements shall be listed in the phasing narrative. Special phasing constraints which may be common to the project during construction should be listed at the end of the narrative and not within each individual phase description.

The A/E shall provide a written list of systems divided by technical discipline, including temporary systems by phase. Additionally, the A/E shall develop a phasing diagram using CPM that shows the sequence and interdependencies of phases within the project.

As the design progresses from pre-design through construction documents, the A/E is responsible to submit an increased level of detail of the construction schedule during each phase. Exhibit I.6 is a sample of a phasing narrative for a typical VAMC project.

3.1.4 Activation Planning/Beneficial Occupancy

The A/E shall communicate with the project stakeholders to understand the complete requirements of a VAMC facility. In this phase, VA medical equipment is installed and activated and the owner's personnel are recruited, trained and mobilized to run the hospital operation.

The Activation phase is very critical to the completion of the project as this is when the beneficial occupancy is achieved and the VAMC or other facilities are ready for veterans use. The VA activation planning phase should commence at the end of Schematic Design (SD-2) phase and should be in parallel with the design and construction phases, overlapping the tail end of construction as necessary.

3.2 Assign Unique Identifiers to the IPMS

The A/E shall assign a unique name and identification number to identify the specific project and each version of the schedule shall have a unique version number or ID. This is essential to allow the proper archiving of project schedules and audit processes.

3.3 Work Breakdown Structure (WBS)

The Integrated Project Master Schedule WBS encompasses the entire project at Level 1. Subsequently, Level 2 of the WBS subdivides the project into major phases that comprise Design, Procurement, Construction and Activation. Level 3 subdivides each of the major work items into work packages as follows:

Pre-Design, Schematic Design SD1 & 2, Design Development DD1 & DD2 and Construction Documents CD1. Level 4 of the WBS shows the twenty seven (27) different design elements. Level 5 of the WBS breaks down the design elements into specific work activities.

The A/E shall develop the WBS to capture the complete project scope in accordance with VA PG 18-15. A typical VA project WBS is as follows:

WBS Level	Title	Description
I	Project	The Project (e.g. VA IPMS)
II	Major Phase	This level subdivides the project into major phases that comprise the project (e.g., design, procurement, construction, activation)
III	Work Package	This level subdivides each of the major work items into work packages or components (e.g., pre-design, schematic design, design development, construction documents)
IV	Major Work Item	This level subdivides each of the major work packages into major work components or deliverables (e.g. architectural design element, site development design, cost estimating, and other
V	Activity	This level subdivides each of the major work items into specific work activities (e.g., prepare and submit basis of design report, VA review and comment on submittals, prepare estimate, and other related work activities)

Table 3

The objective is to establish appropriate levels of schedule detail for planning, scheduling, monitoring, controlling and reporting on the overall project.

The work breakdown structure and the levels of schedule detail established for the project should allow information to be accurately transferred from one level of schedule detail.

For a typical VAMC project, as many as five levels of schedule detail may be utilized by the A/E. A description of these levels follows:

Level 1: Integrated Project Master Schedule – Consists of a bar chart or a time-scaled network of 15 to 50 activities. This level of detail can be useful for periodic management briefings and reporting. (See Exhibit I.1)

Level 2: Summary Design Schedule – Design activities are summarized in this schedule to cover all phases of the project. This is the schedule that is used to plan, implement, and control the various design phases such as SD1, SD2, DD1, etc. (See Exhibit I.2)

Level 2: Overall Construction Schedule – A/E shall develop a construction schedule based on phasing, major trade activities at summary level (Level 2), long lead items, overall critical path, and VAMC operational needs. This schedule is intended to validate the phasing and anticipated construction duration. (See Exhibit I.3)

Level 3: Detailed Design Schedule – Detailed design activities are provided to show staff requirements, task deliverables and subcontract requirements of each discipline. (See Exhibit I.4)

The following levels are more detailed schedules which the A/E may use at their discretion:

Level 4: One- or two-month Look-Ahead Schedules – Schedules that are prepared each week and in advance of the next two or three weeks of planned efforts. These may be prepared for each of the major design disciplines and may be in bar chart form or in simple network abstracts. These schedules should include the identification of all required resources (equipment and manpower by craft/trade) on a daily basis. (See Exhibit I.5)

Level 5: Daily Work Schedules – These schedules are used mainly for construction; however, the A/E may develop and use them to manage detailed design activities. These schedules should be prepared at least one day in advance and with the participation of field superintendents, area supervisors, craft supervisors, foremen, and so on. The objective is to plan, schedule, and coordinate on a daily basis the required labor, construction equipment, and materials needed for each work task. In addition, they need to communicate work task versus cost accounting information essential for

capturing and documenting actual field costs. These include not only base contract work, but also changes, problems, and areas of potential disputes. Such schedules can also aid in capturing manpower data and measuring labor productivity.

3.4 Define Project Milestones

Milestones are key events or significant points in time during the life of a project. Once the A/E has a feel for the overall scope of the project, he or she can begin to determine the project's major and minor milestones. Milestones should have zero duration and be used as the bench marks to measure progress against.

They can also reflect the start and finish points for various project events or conditions and/or identify external constraints or interim deliverables. At a minimum the detailed design schedule, developed by the A/E shall contain start and finish milestones culminating to each design phase (Pre-Design, SD1, SD2, DD1, DD2, and CD1). This will facilitate tracking of the A/E progress for each contractual deliverable.

3.5 Establish Project Calendars and Work Periods

The A/E shall determine, in conjunction with the project team, the work periods which need to be selected for the design phase of the project. These work periods may be different for specific activities or portions of the project including resources. The A/E shall consider the following prior to establishing a calendar:

- The proposed number of working days in a week
- The number of hours to be worked each day
- Any periods of scheduled overtime work or non-working time (e.g. shutdowns)
- The holidays to be observed during the life of the contract (by day, month, and year)

All of these elements play a major role in determining the number and structure of the project calendars required for the IPMS. The use of multiple calendars introduces significant complexity to the calculation of float and the critical path. However, while scheduling is simplified by the use of a single calendar, the A/E shall be cognizant that one calendar may not suffice for effectively managing the project.

The A/E shall utilize project calendars which are adequate and reasonable to perform the scope of work, based on normal working times. The project calendar then may be used as the primary or default calendar for the project. A limited number of customized calendars may then be used for areas of the project requiring different working times.

The sample IPMS includes a 5-day work week calendar w/holidays for all activities in the detailed design schedule and 7-day workweek calendar with no holidays for the summary level construction activities.

3.6 Activity Identification/Coding

The A/E shall assign unique number to each activity/event with numbers ranging from 1 to 99998 only for the activity identification. The A/E shall utilize software where once the activity ID is created, it will not change due to the addition or deletion of activities, this is paramount to guarantee the traceability of the schedule

The CPM schedule activities should be generally coded in such a way to reflect disciplines, phase or location of the work. The A/E shall develop a coding structure to facilitate the selection and sorting of the schedule data, and to facilitate the development and maintenance of the IPMS, as well as meeting the project reporting requirements. A well designed coding structure is also very helpful in analyzing project performance data by facilitating aggregation selection and sorting to highlight trends and anomalies.

The IPMS shall be categorized and the activities/events coded as listed below:

RESP: Responsibility determines the party responsible for the activity as shown below:

Architect

Mechanical Engineer

Fire Protection Engineer

Electrical Engineer

Veteran Affairs

Other Government Agencies

AREA: The A/E shall use this code to assign design element coding such as Architectural, HVAC, Fire Protection, and other related design element coding.

PHASE: The A/E shall use this code to divide the items of work into different phases within the Project such as Pre-Design, Schematic, Design Development, and other project phases.

3.7 Activity Definition

The A/E, in conjunction with the project team members responsible to perform the work of the project, should create the list of activities that will need to be performed to complete the project. The Sample IMPS includes activities related to the design submission requirements for VAMC Major New Facilities, Additions and Renovation as detailed in PG 18-15.

The A/E shall consider the following to break down the scope of work into manageable activities for the detailed schedule of the design, procurement and activation:

- The A/E shall show a concise description of the work represented by the activity/event (35 characters or less including spaces preferred).
- The A/E shall describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled “start,” “continue,” or “completion,” are not specific and will not be permitted. Lead and lag time activities will not be acceptable.
- The A/E shall designate a single entity that shall be responsible for performing the activity. This does not preclude the idea that multiple resources may be required to accomplish the activity, but it does require that a single entity is responsible for its performance. That person should be the same one who will report progress on the activity (Performance Responsibility).
- Duration of activities/events shall be in work days.
- Activities/events shall have cost assigned to them. Cost shall not exceed \$99,999 per activity.
- The A/E shall show activities/events for work for each discipline.
- Each activity/event on the computer-produced schedule shall contain as a minimum, but not limited to, activity/event ID, duration, predecessor and successor relationships, area code, trade code, description, budget amount, early start date, early finish date, late start date, late finish date and total float. Work activity/event relationships shall be restricted to finish-to-start and start-to-start without lead or lag constraints (Exception allowed with approval).
- The A/E shall break up the work into activities/events of duration no longer than 20 work days each, except for which the Project Manager and/or the Contracting Officer may approve the showing of a longer duration (long, continuous design activities and procurement activities where a single work item such as fabricating and delivering/shipping a component to a remote site).
- The A/E shall adhere to the VA NAS specification for A/E design.

For the summary level construction schedule, the A/E shall break down the schedule into the proposed phasing plan. The A/E shall assign reasonable durations to the activities and assign a 5-day work week calendar to each construction activity contained in the IPMS.

When complete, the A/E shall confirm that the activity list in the IPMS shall describe 100% of the work required to complete the project in its entirety, although the construction element of the IPMS will be developed at a summary level until the time for that work draws nearer.

3.8 Activity Sequencing

The A/E shall show on the CPM Schedule the sequence and interdependence of work activities/events required for complete performance of all items of work. For instance, in the design component of the IPMS, the A/E shall depict in sequence the relationship between A/E submittals, VA Approval, Peer Reviews, Design Review meetings, and other required work activities/events.

Work activity/event relationships shall be restricted to finish-to-start and start-to-start with no lag constraints. Activity/event date constraints not required by the contract will not be accepted unless submitted to and approved by the Contracting Officer.

The A/E shall make a separate written detailed request to the Contracting Officer identifying these date constraints and secure the Contracting Officer's written approval before incorporating them into the CPM Schedule. The Contracting Officer's separate approval of the CPM Schedule shall not excuse the A/E of this requirement (See NAS Specification).

In the construction phase of the IPMS, the A/E shall depict in sequence the interdependencies among the construction phasing from the issuance of the Construction Notice-To-Proceed all the way through Project close out activities. This shall include constraints particular to each phase, what other phases must precede it, other contractors working in that phase, and any VA moves/relocation which must precede the start of the phase or phases.

3.9 Estimating Activity Duration

The A/E shall define the activities/events first, and then the A/E shall tie the activities/events logically into the overall schedule sequence and then the A/E shall focus on how long it will take to accomplish the work. The A/E shall use the following guidelines in estimating activity durations for design, procurement and activation:

- Expert judgment guided by historical information.
- Analogous estimating based on experience on similar projects.
- Parametric estimating based on formulas describing relationships among project parameters and time.
- Use of simulations to develop distributions of probable duration of each activity
- Consider each activity/event independently.
- Skip around the network when assigning duration estimates to specific activities. Avoid following a path of activities all the way through the network and to the end.

- Activity duration shall be in work days based on physical work content. Example: Complete SD-2 foundation design, 50 drawings (1,000 man-hours, 20 days with 4 structural designers).
- The A/E shall break up the work into activities/events of duration no longer than twenty (20) work days, except for the construction schedule and for which the Project Manager and/or the Contracting Officer may approve the showing of a longer duration. Exceptions to this rule are procurement activities, certain approvals, concrete curing, and so on.

In order to estimate duration for the construction and activation phases of the IPMS, the A/E shall coordinate with the VA and the project stakeholders. The A/E shall assign reasonable durations to each component of the construction phasing in the IPMS. The A/E shall take into consideration physical conditions, safety requirements, and any labor agreements that may be in effect. The activity duration for the Level 2 construction schedule shall be in calendar days with the timescale showing months and years.

3.10 Cost Loading Requirement

The A/E shall cost load all work activities pertaining to the design phase of the project from concept design through construction documents in the IPMS. The A/E is not responsible for cost loading the procurement, construction, and activation phases. The cost loading shall reflect the appropriate level of effort of the work activities/events. The cumulative amount of all cost loaded design activities/events (including alternates) shall equal the total contract price for the engineering part of the IPMS. Prorate overhead, profit, and general conditions on all work activities/events for the entire project length. The A/E shall generate from this information cost projection curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place based on both early and late finish dates. These cost projection curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading. In the event of disapproval, the A/E shall revise and submit in accordance with NAS specifications. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

The A/E is expected to update the cost at the end of each deliverable. For example, once the schematic development SD1 phase is completed and submitted to the VA for review and comment, the A/E shall cost load the affected design activities associated with the deliverable. Exhibit I.7 depicts a sample design phase baseline cost projection S-curve that should be produced by the A/E upon completion of each deliverable.

3.11 Analyzing the Schedule Output

Once complete with developing the IPMS, the schedule will contain a number of unique activities, of varying durations, logically linked together. The A/E shall analyze the IPMS to calculate the dates and other values of the IPMS.

The A/E shall provide to the VA Project Manager, Contracting Officer and CPM Schedule Analyst, all computer-produced time/cost schedules and reports generated from the software as required by the A/E spec.

The Project Manager shall identify the different report formats such as early start total float report, and late start total float report, that the A/E shall provide based upon the schedule output.

The A/E shall generate cash flow curves indicating graphically the total percentage of work activity/event dollar value scheduled to be in place on early finish, late finish. These cash flow curves will be used by the Contracting Officer to assist him in determining approval or disapproval of the cost loading.

3.12 Narrative Report

As part of the schedule development, the A/E shall submit a baseline schedule narrative report and subsequent monthly narrative report as part of his monthly review and update, in a form agreed upon by the A/E and the Contracting Officer. The narrative report shall include, at a minimum: changes due to design affecting construction; a description of problem areas; current and anticipated delaying factors and their estimated impact on performance of other activities/events and completion dates; and an explanation of corrective action taken or proposed. A typical breakdown of a design schedule outline narrative report is included as Exhibit I.8.

In addition to providing a narrative report, the IPMS developed by the A/E should allow for high level schedule reporting based on the need of the VA and the project stakeholders. For instance, the A/E shall provide the longest path of the project during each schedule update as depicted in Exhibit I.9.

3.13 Approving the Schedule

Within 30 calendar days after receipt of Notice to Proceed, the A/E shall submit for the Project Manager and Contracting Officer's review; three copies of the complete CPM Schedule and an electronic backup file from the scheduling software, The submittal shall also include three copies of a computer-produced activity/event ID schedule showing project duration; phase completion dates; and other data, including event cost.

The final CPM Schedule in its original form shall contain no contract modifications or changes which may have occurred during the final CPM Schedule development period and shall reflect the entire contract duration as defined in the bid documents.

The A/E, VA and key stakeholders shall be actively involved in reviewing the results of the initial scheduling process. The review shall consider the analyzed project end date, milestone completion dates and resource requirements to determine the acceptability of the schedule.

These iterations continue until an acceptable project schedule is developed, one that all of the relevant project stakeholders can agree with.

3.14 Baselining the Schedule

Once agreed by all project stakeholders, the A/E shall designate the final version of the initial schedule as the Baseline. This baseline becomes the benchmark against which project performance will be measured. In accordance with good scheduling practices, the A/E shall have a Baseline Schedule in place before the execution of the project work commences. Once the Baseline has been agreed, reports are distributed in accordance with the project's communication plan.

4 UPDATING/MAINTAINING THE INTEGRATED PROJECT MASTER SCHEDULE (IPMS)

The primary purpose of updating the IPMS is to report on and evaluate the current status of the work, based on progress to date, and to forecast a realistic project completion date given that progress.

The A/E will be responsible for updating the detailed design activities of the IPMS on a monthly basis to facilitate progress payments. However, at the submission of each deliverable (SD1, SD2, DD1, DD2), the entire schedule shall be updated to evaluate the effects of changes/improvements in the design.

Monthly progress meetings shall be held on dates mutually agreed to by the Project Manager and/or Contracting Officer and the A/E. The A/E shall update on a monthly basis the project schedule, including actual start and finish dates, and actual % complete of each activity in progress. All schedule data required shall be accurately filled in and completed prior to the monthly progress meeting. The A/E shall provide this update to VA three (3) work days in advance of the progress meeting. Job progress will be reviewed to verify:

- 1 Physical percent complete (%) of each activity.
- 2 Actual start and/or finish dates for updated/completed activities/events.
- 3 Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
- 4 Logic, time and cost data for change orders, and supplemental agreements that are to be incorporated into the CPM schedule.
- 5 Percentage for completed and partially completed activities/events.
- 6 Logic and duration revisions to keep the schedule current.
- 7 Activity/event duration and percent complete shall be updated independently.

With each invoice, the A/E shall submit an updated schedule and the following reports, for review and approval, to the Project Manager:

1. Detailed Design Schedule, including Critical Path (Longest Path),
2. Cost Earned Report as basis for the Invoice,
3. Sixty (60) day look Ahead/Hot list report,
4. Update Schedule Narrative that explains all the changes performed to the schedule.

5. CHANGE ORDERS

The IPMS in its original form shall contain no contract modifications or changes which may have been incurred during the final CPM schedule development period and shall reflect the entire contract duration as defined in the bid documents. These changes/delays shall be entered at the first update after the final CPM schedule has been approved.

The A/E should provide their requests for time extension for contract time as a result of contract changes/delays in the design phase after the first schedule update. The time extension must be supported by CPM data and analysis, justification narrative, related documents and etc for VA approval.

The A/E shall submit each request for a change in the contract completion date to the VA in accordance with the provisions specified under Article, FAR 52.243 -4 (Changes), VAAR 852.236 – 88 (Changes – Supplements). The A/E shall include, as a part of each change order proposal, a fragnet showing all CPM logic revisions, duration (in work days) changes, and design cost changes, for work in question and its relationship to other activities on the approved CPM schedule (See Exhibit I.10 as a reference). All delays due to non-work activities/events such as RFIs, weather, strikes, and similar non-work activities/events shall be analyzed on a month by month basis.

6. EXHIBITS

- Exhibit I.1.** Level 1 Schedule for a Typical VAMC Project
- Exhibit I.2.** Level 2 Schedule for a Typical SD-1 VAMC Project
- Exhibit I.3.** Level 2 Schedule for a Typical Construction Phase in VAMC Project
- Exhibit I.4.** Level 3 Schedule for a Typical SD-1 VAMC Project
- Exhibit I.5.** Level 4 Schedule (60-day look ahead) for a Typical SD-1 VAMC Project
- Exhibit I.6.** Sample Phasing Narrative for a Typical VAMC Project
- Exhibit I.7.** Cost Projection S-Curve for a Typical Design Phase in VAMC Project
- Exhibit I.8.** Sample Outline for a Schedule Narrative Report
- Exhibit I.9.** Longest Path for a Typical Design Phase in VAMC Project
- Exhibit I.10.** Schedule Impact Analysis – Sample Change Order Fragnet

EXHIBIT I.1

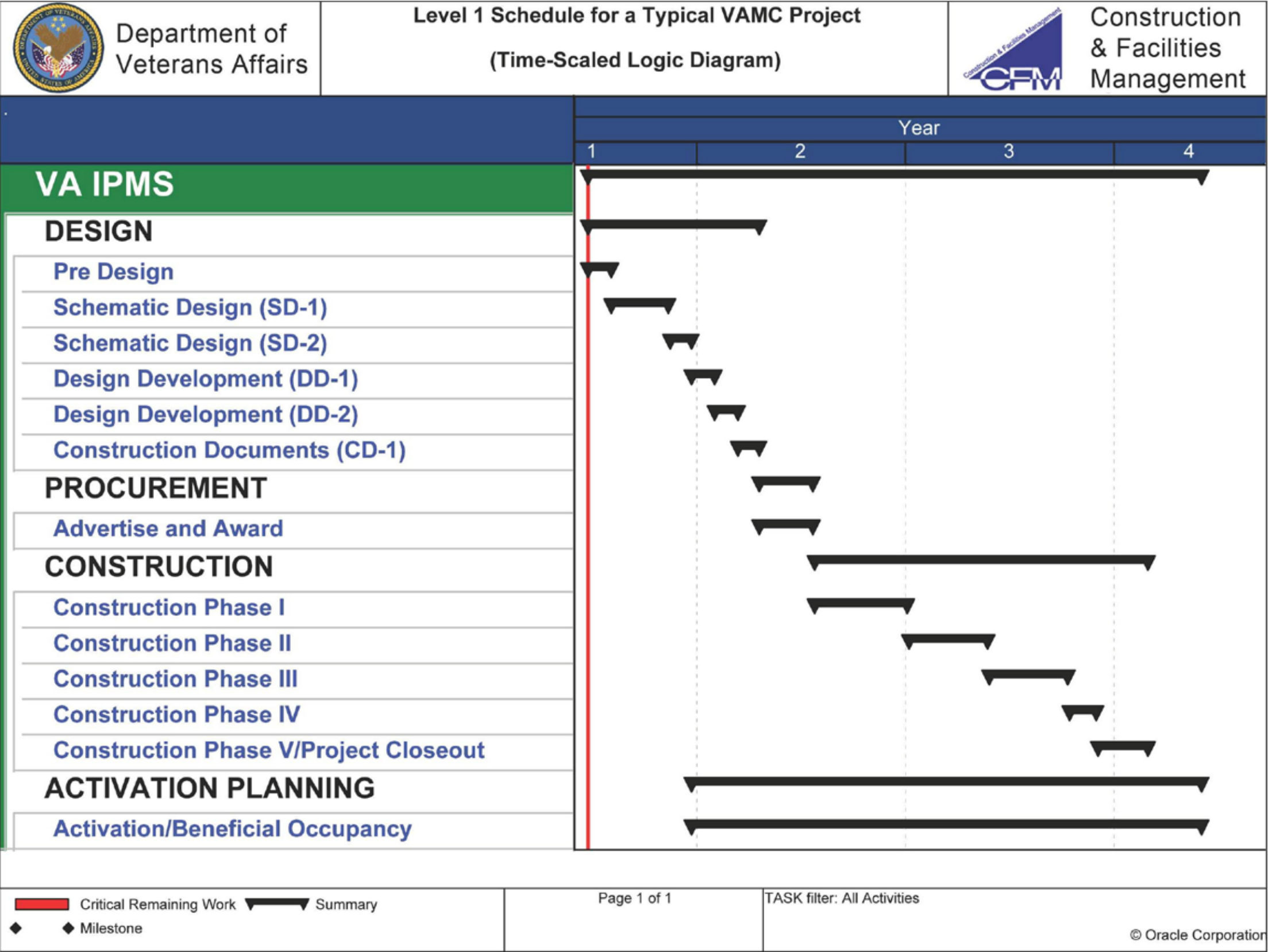


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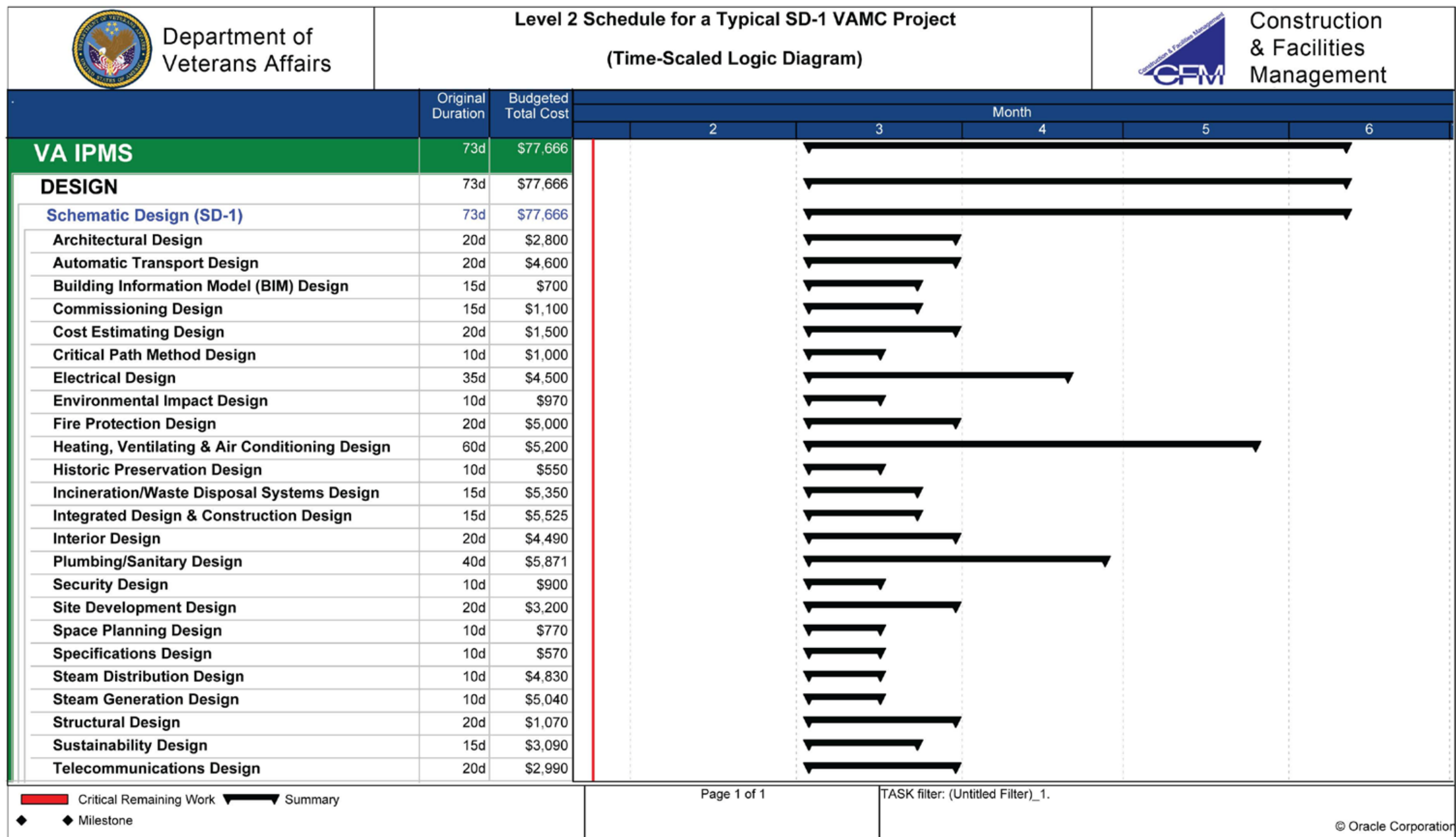


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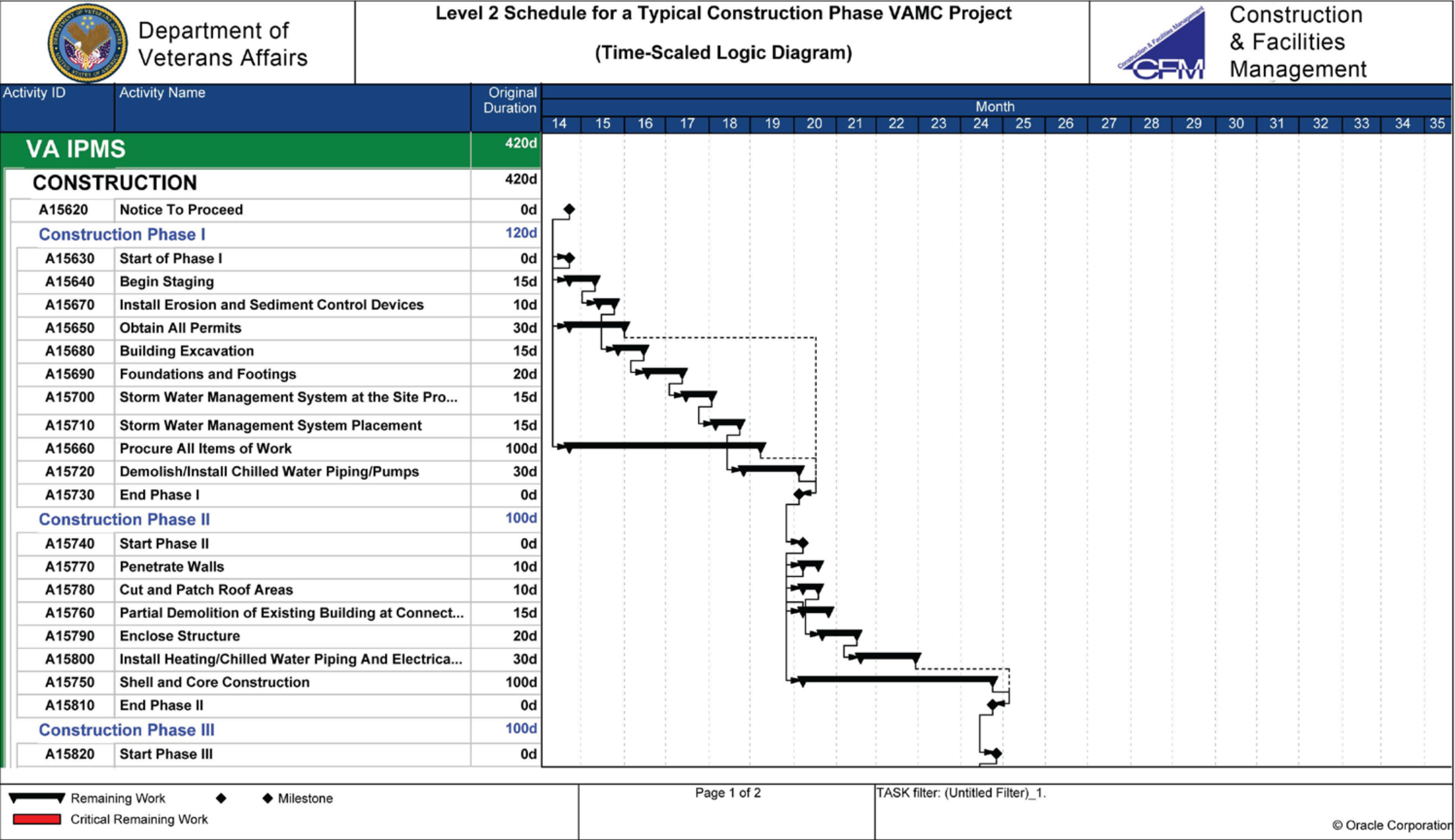


EXHIBIT I.3



Department of
Veterans Affairs

EXHIBIT I.4

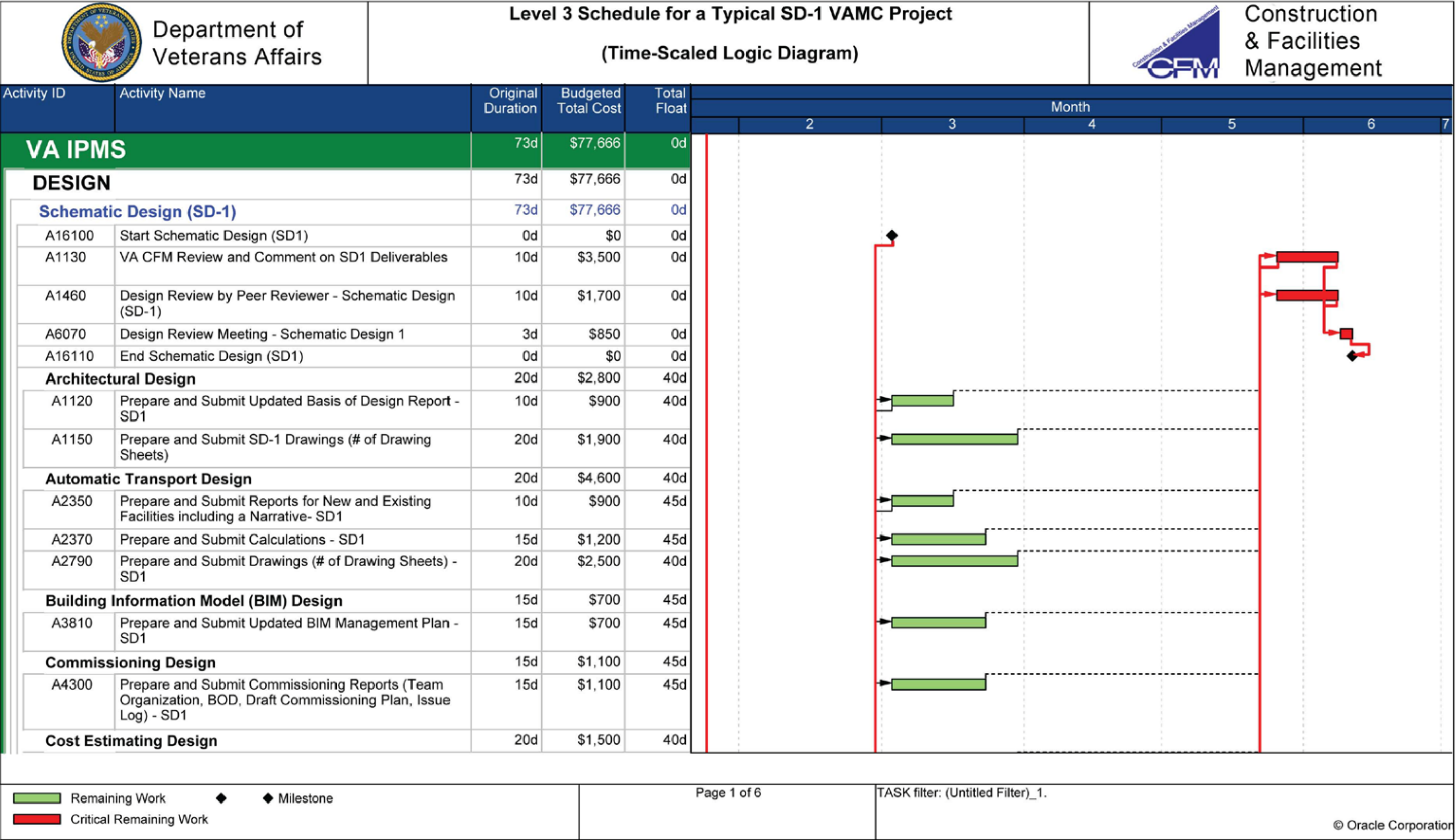


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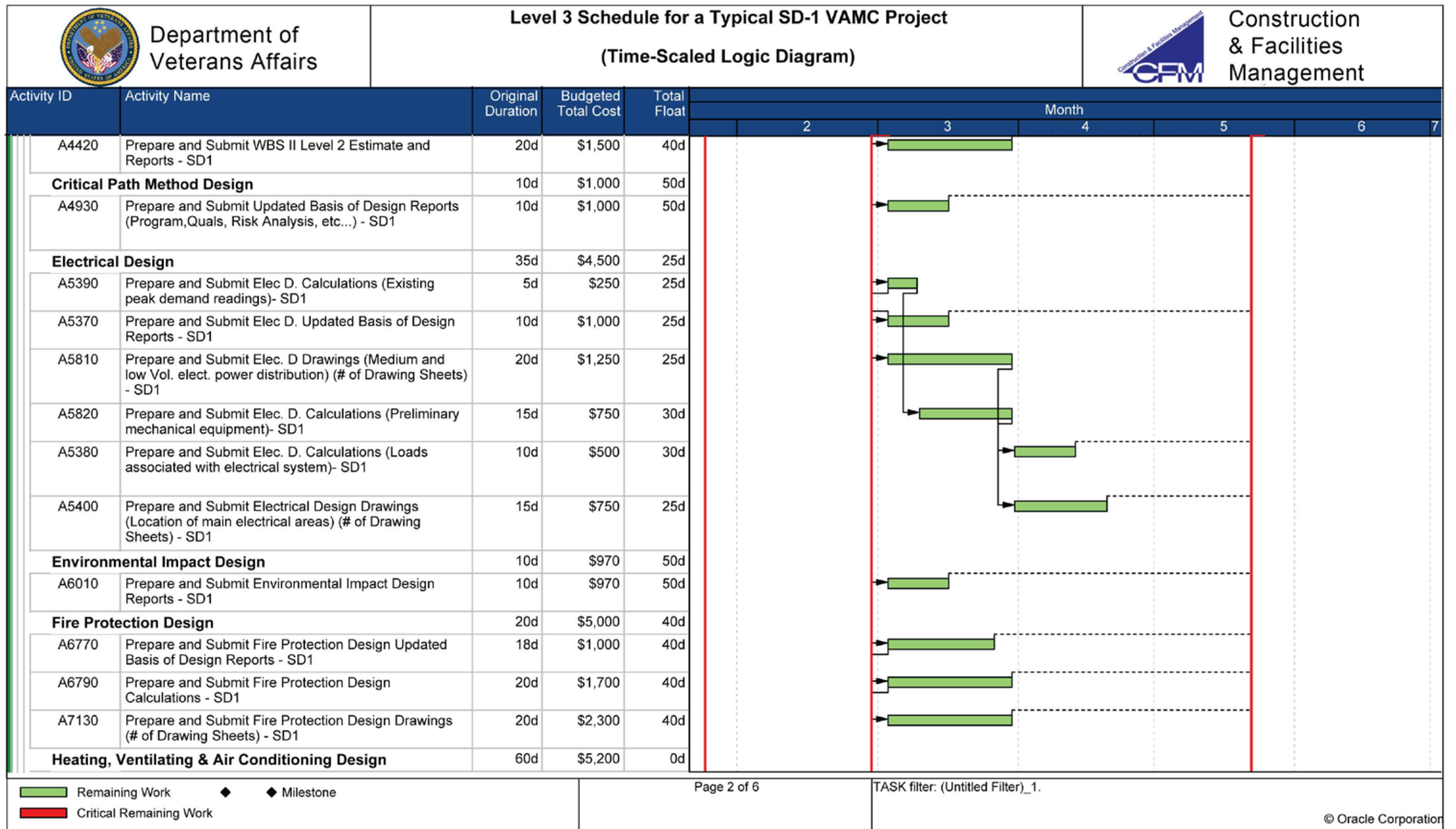


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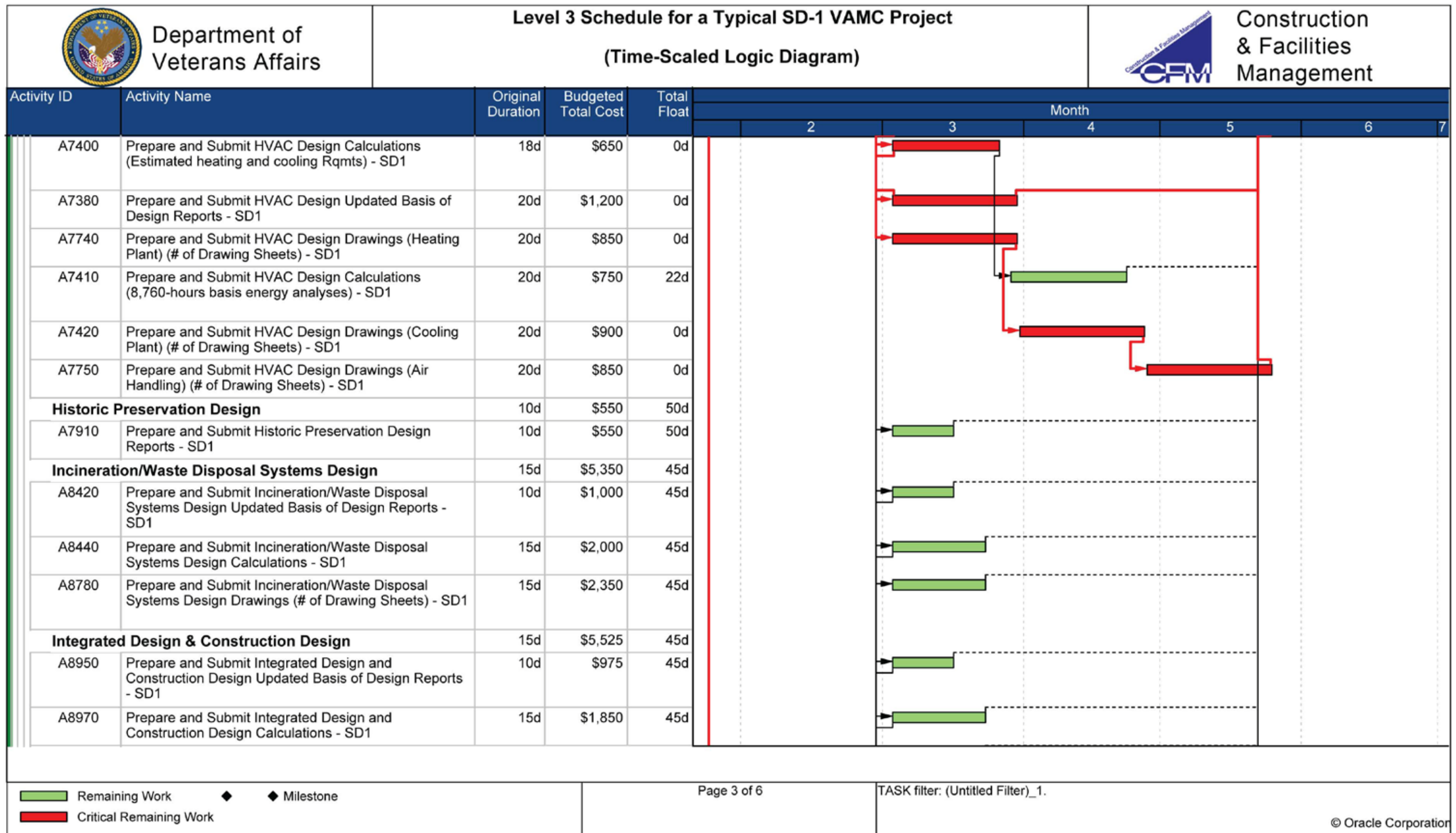


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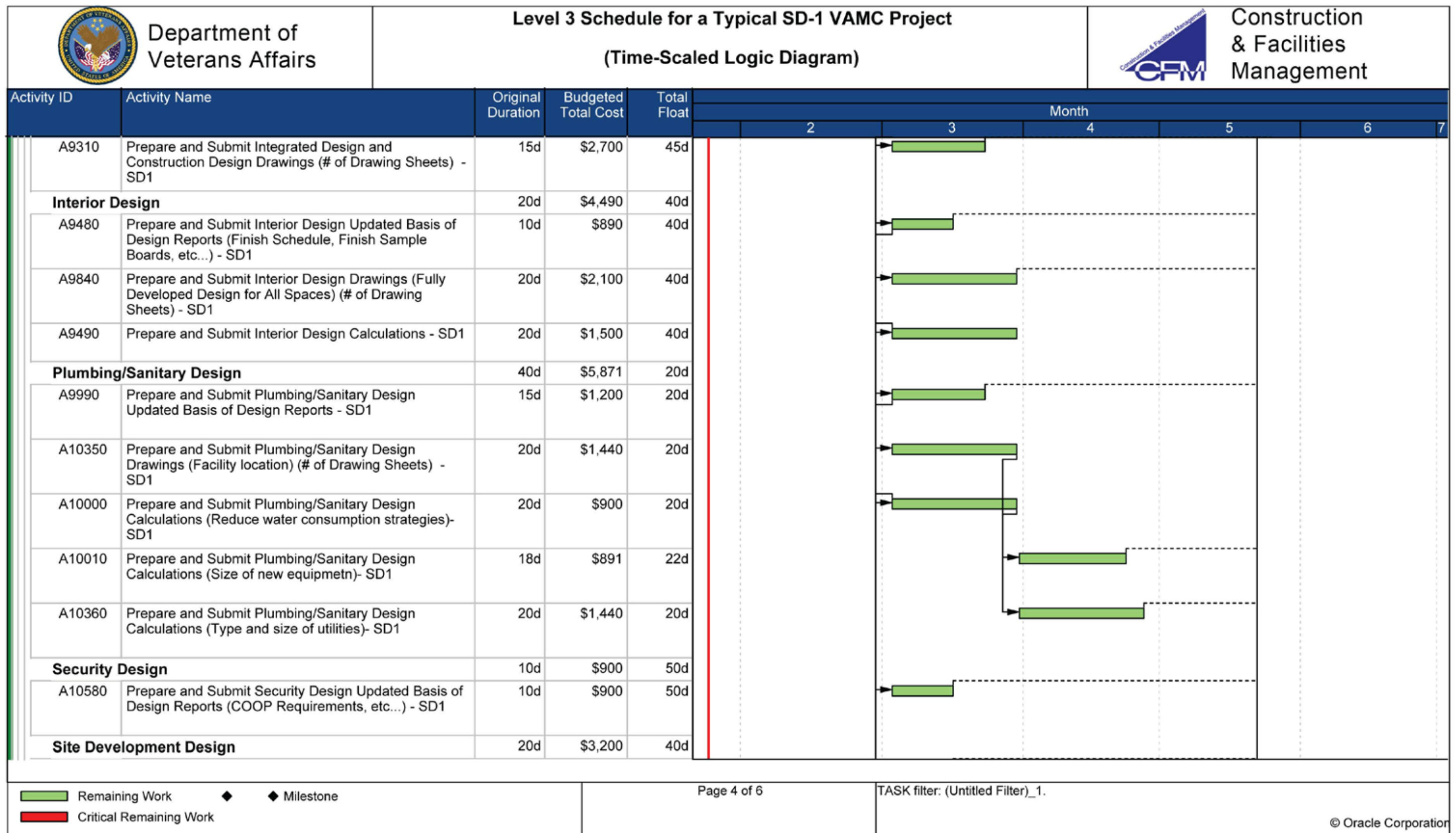


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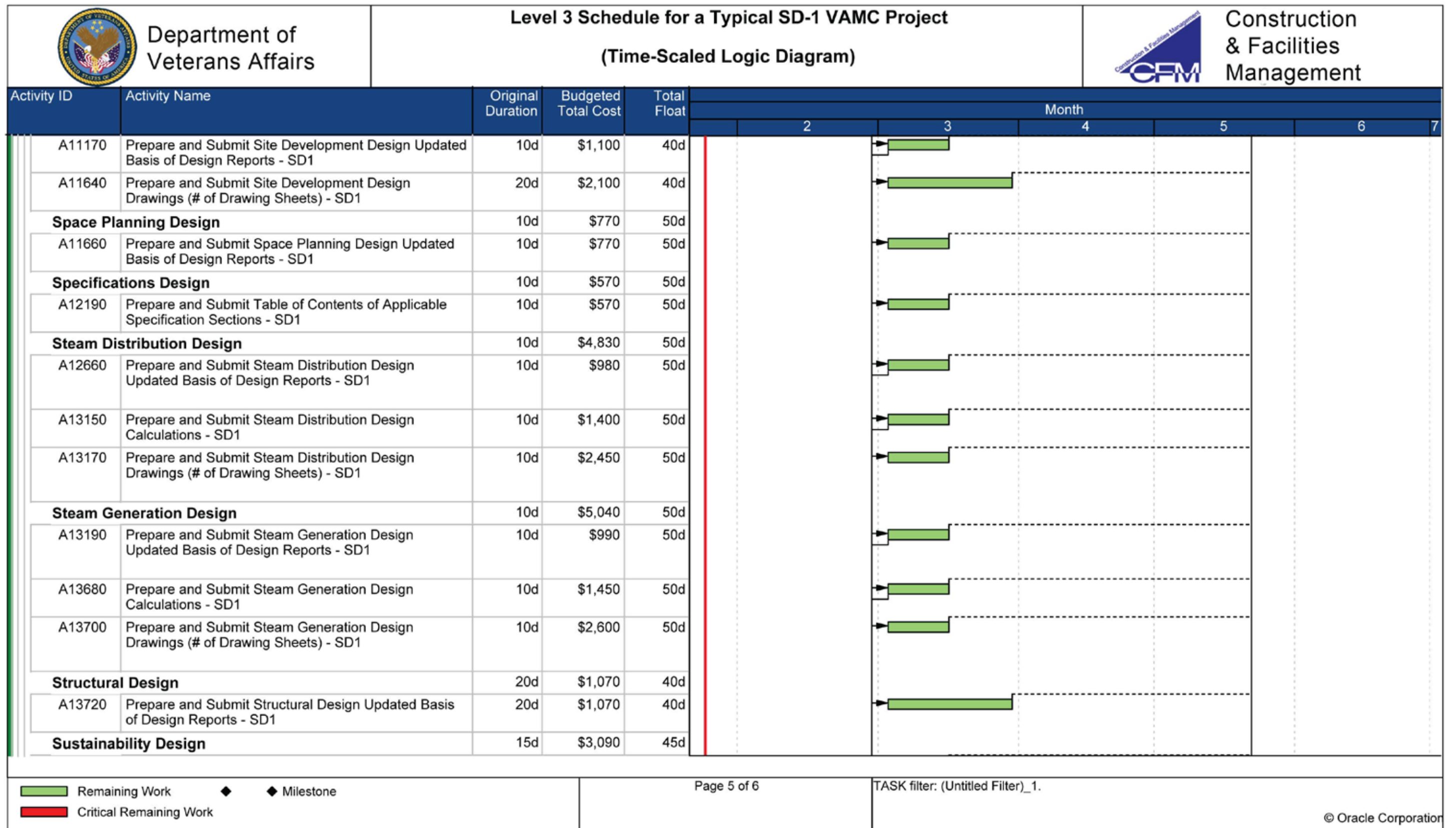


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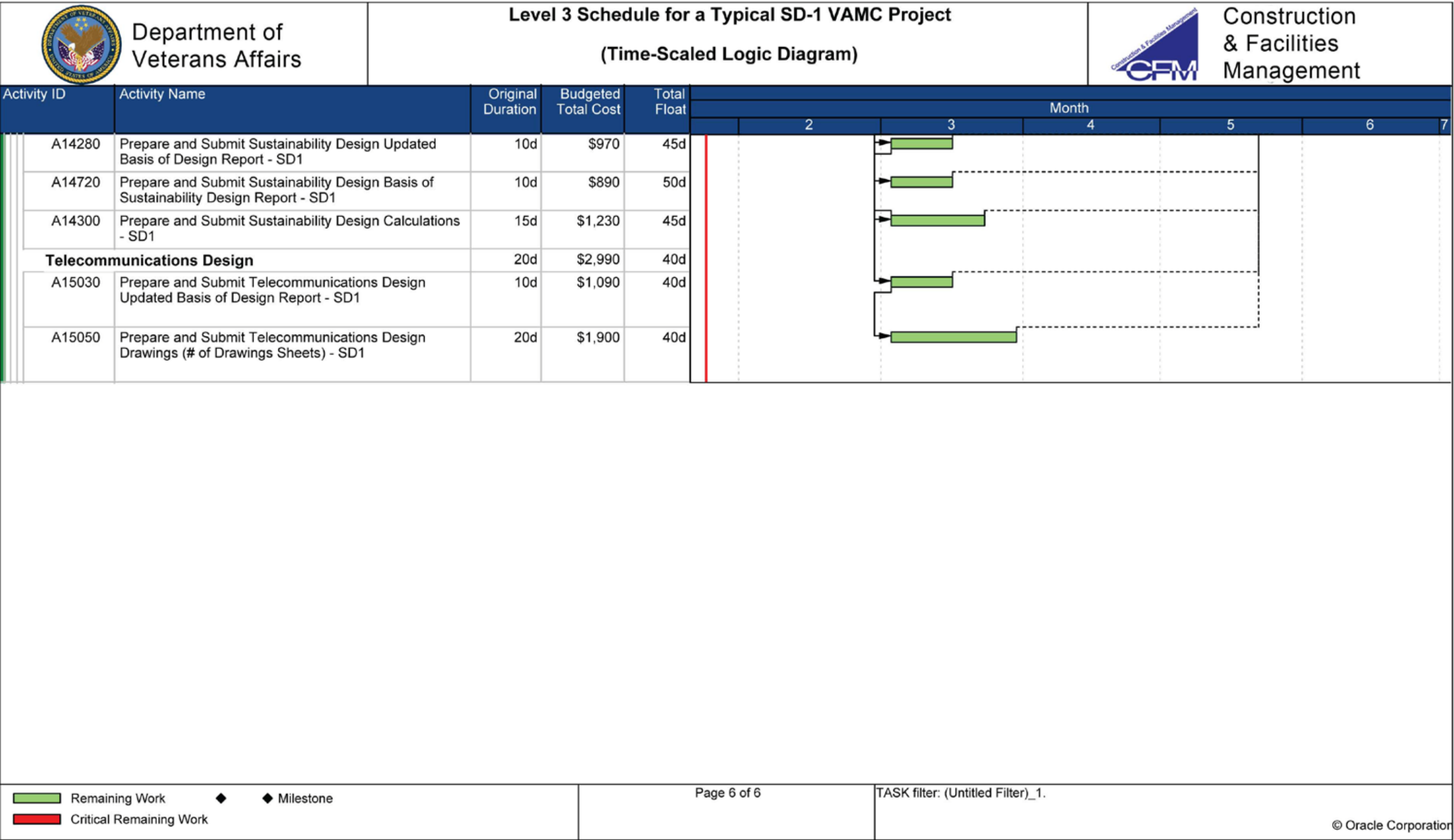


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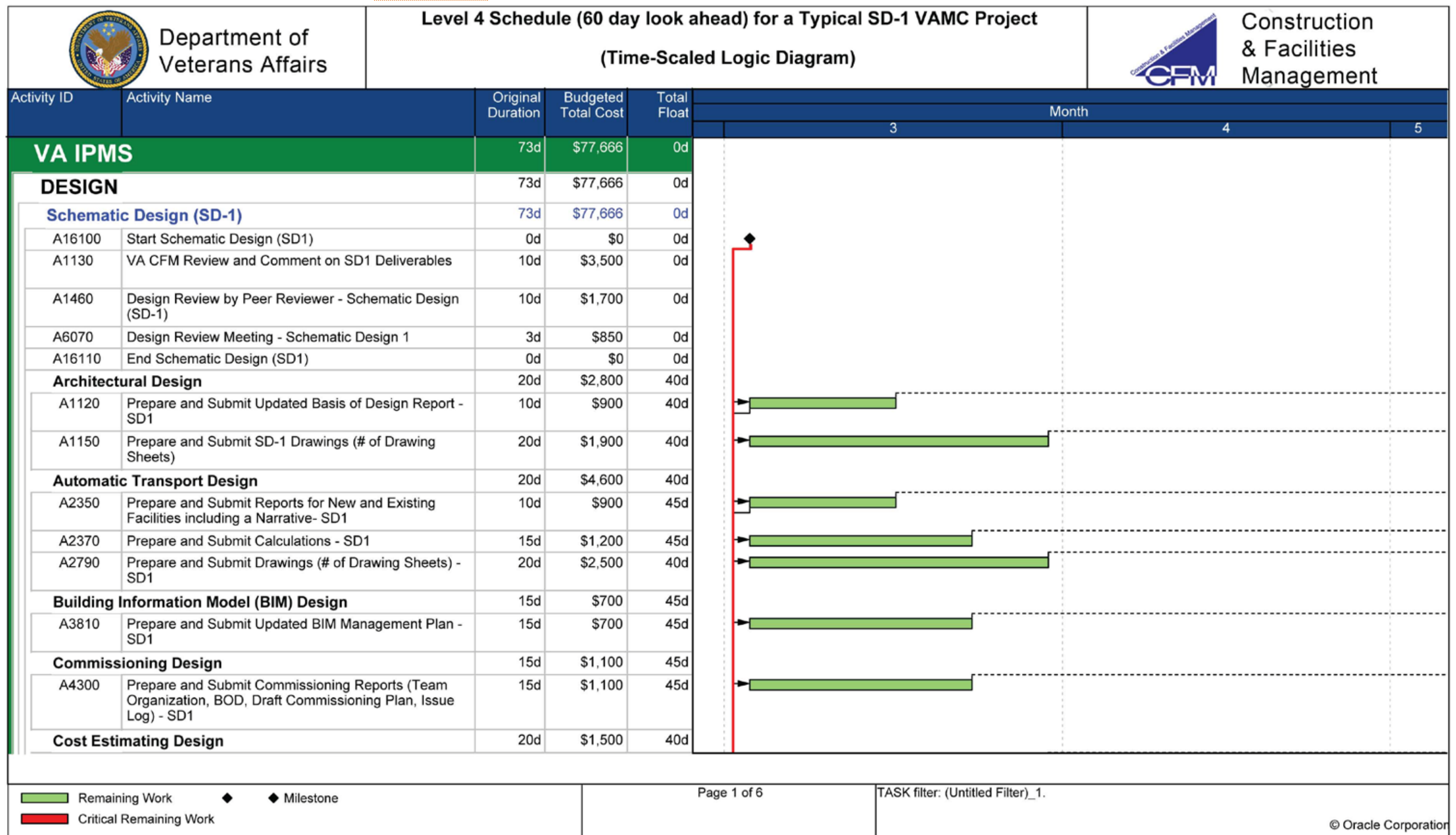


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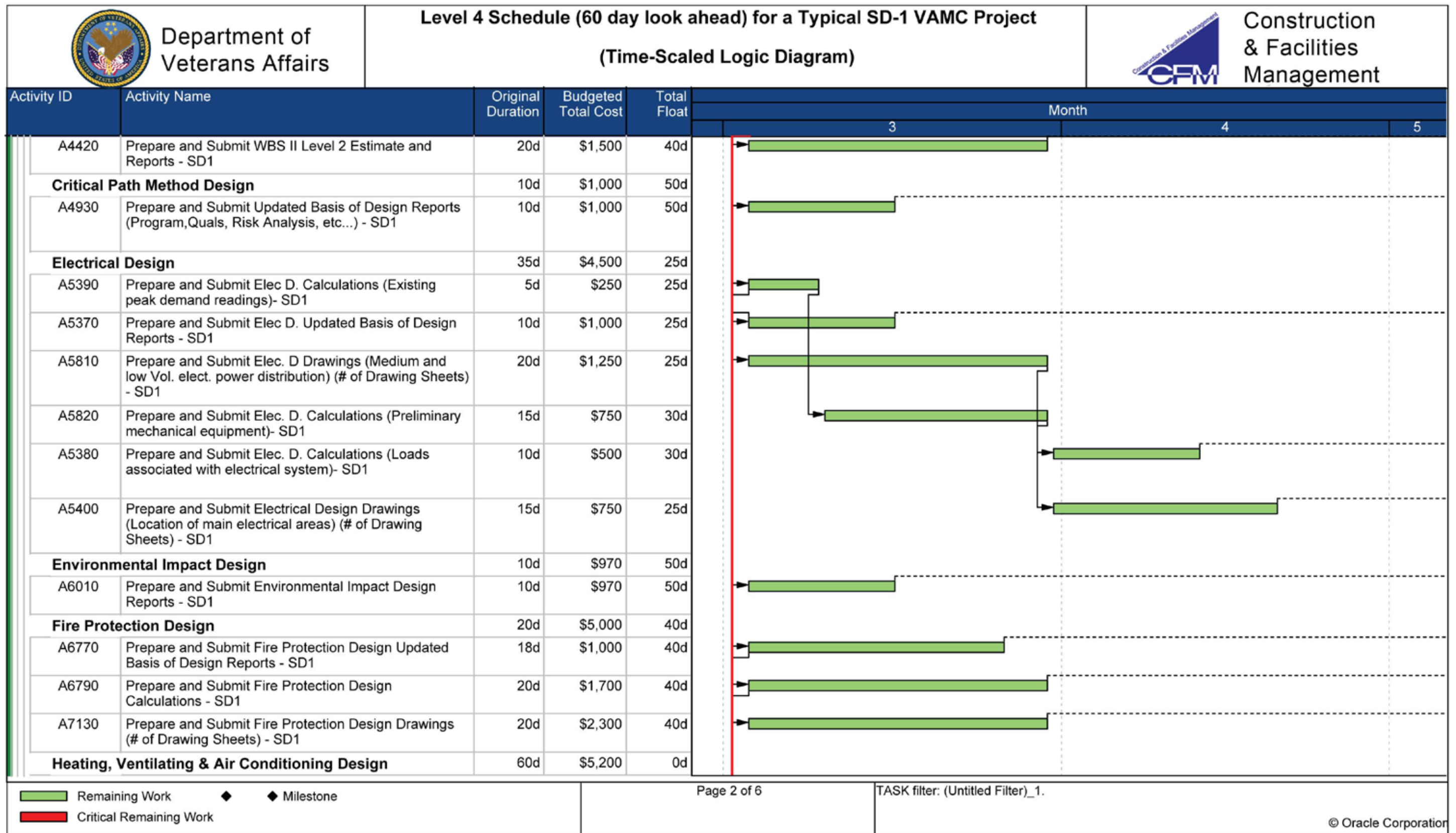


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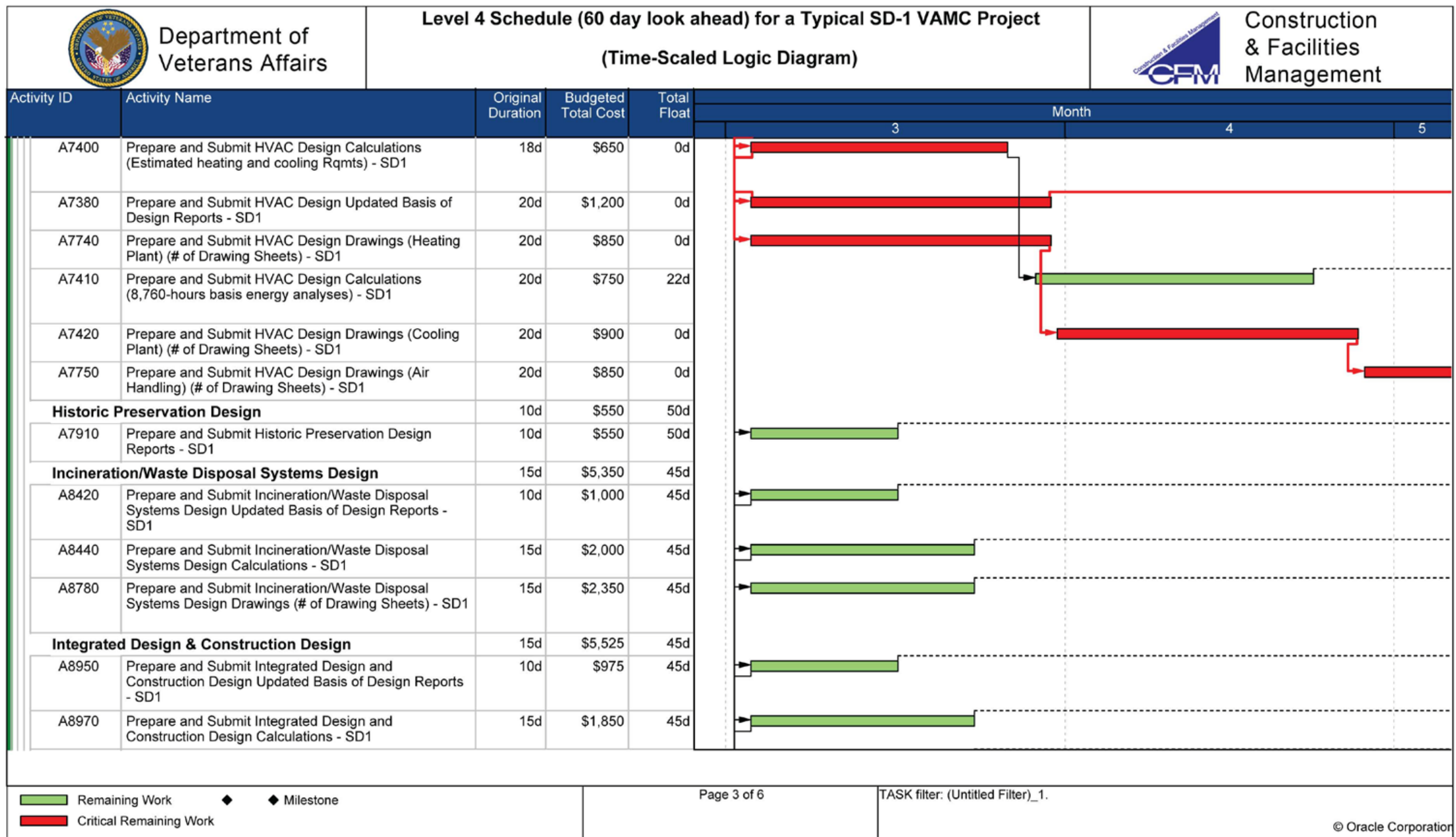


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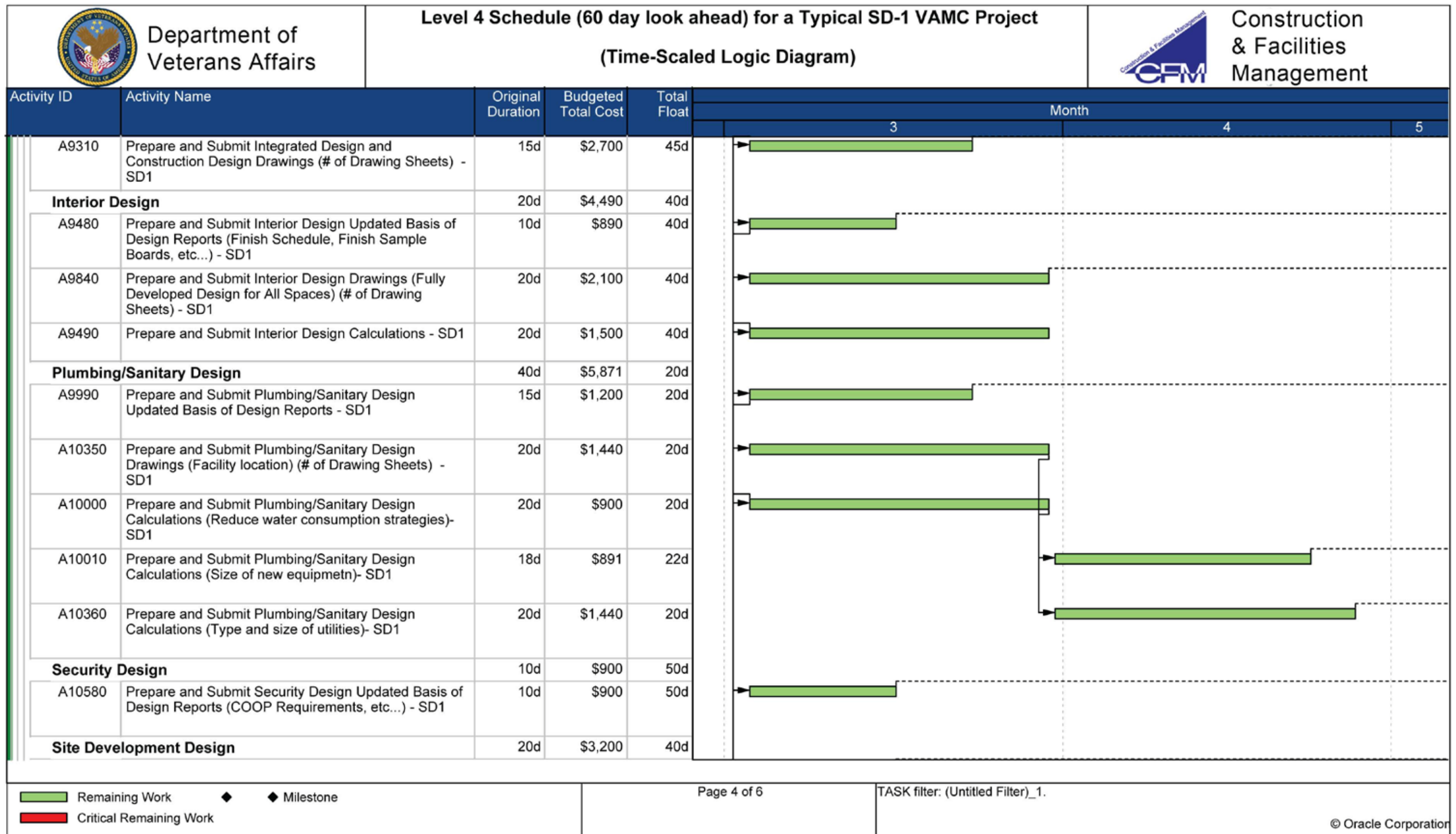


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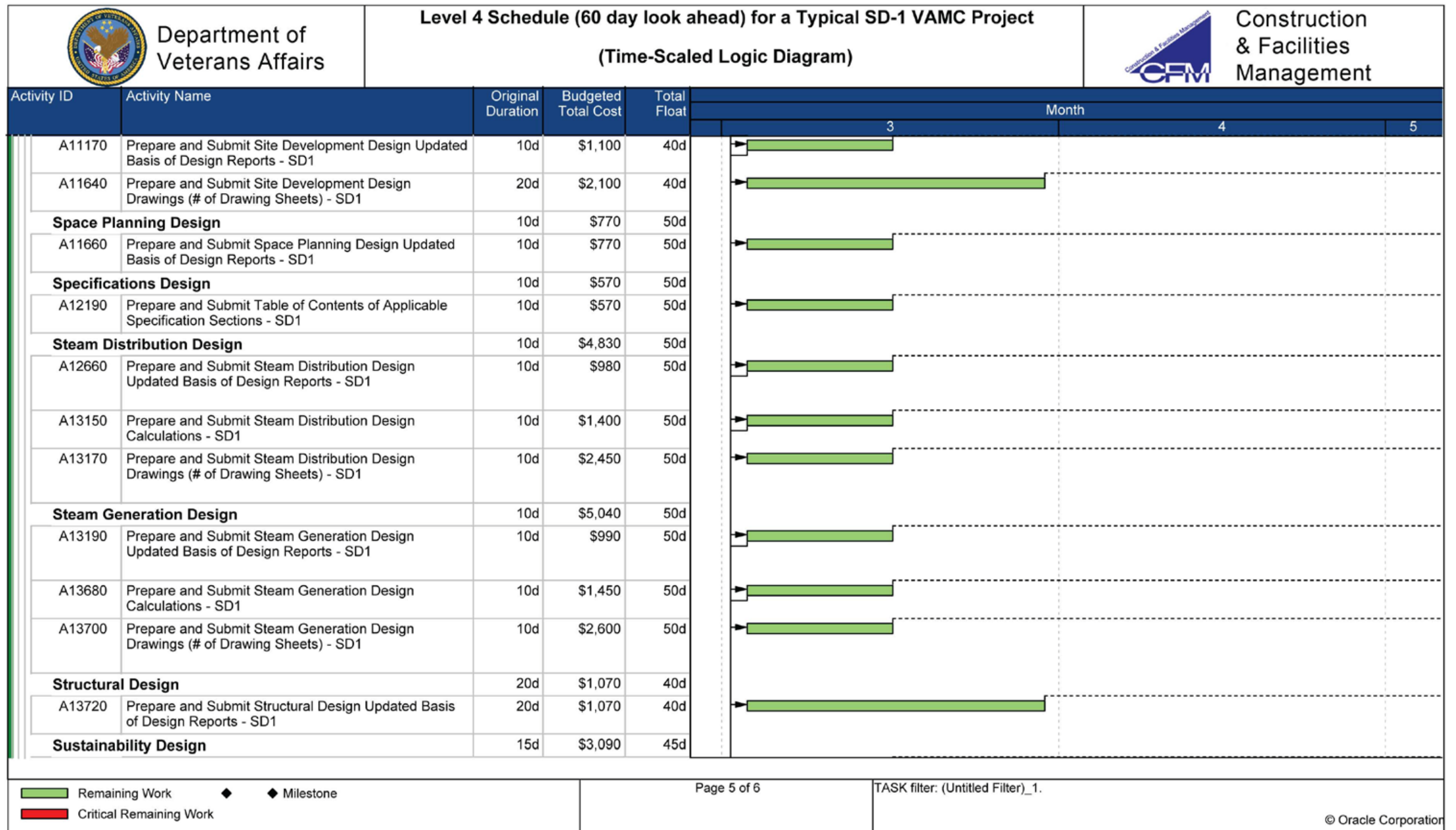


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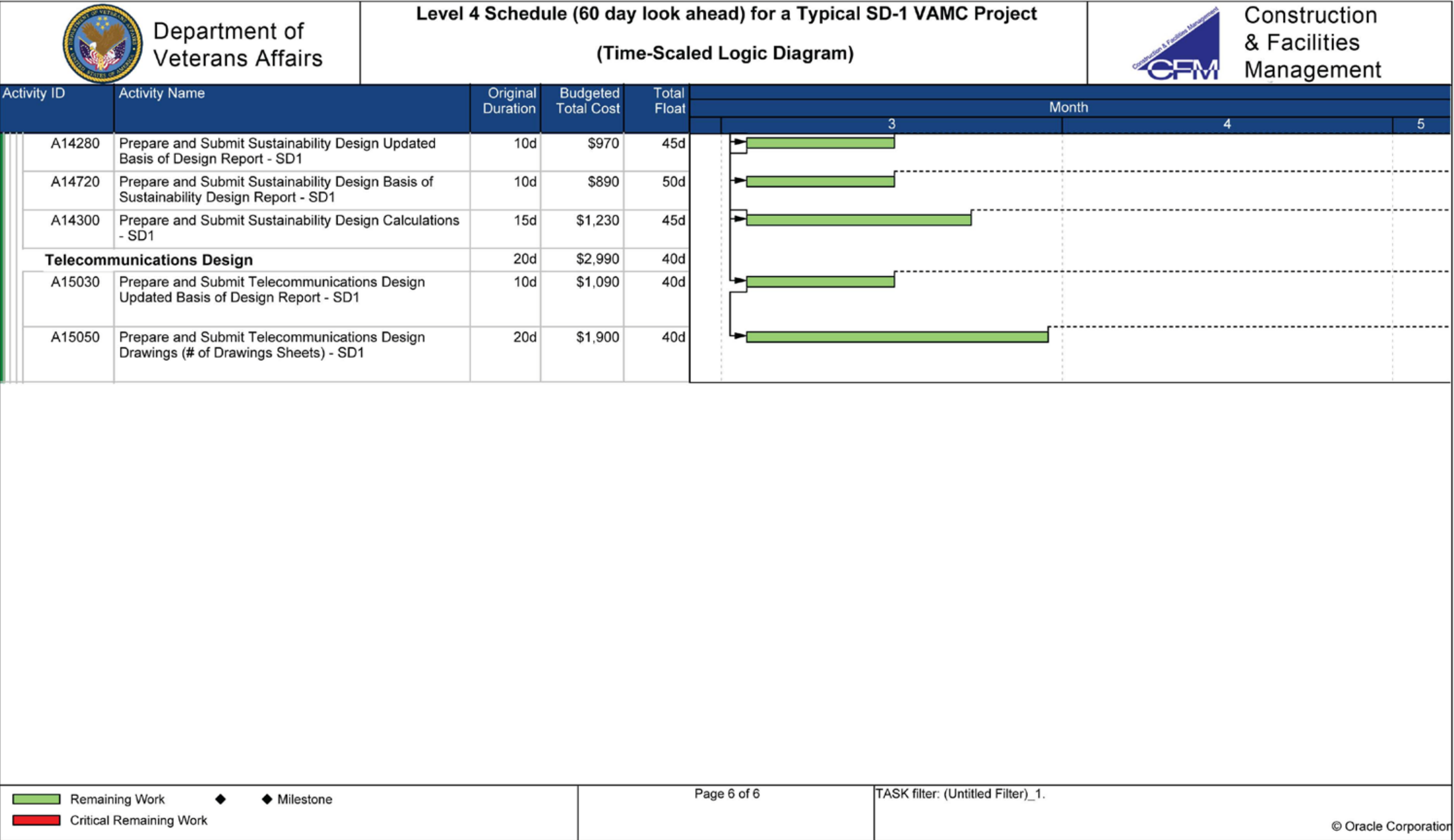


EXHIBIT I.6

SAMPLE PHASING NARRATIVE

GENERAL: Work under this contract shall be divided into phased areas with durations. The contractor shall perform the work in each phase in the sequence shown on the phasing plan. All work in each phase must be completed prior to VA occupancy of a phase and the start of work in a subsequent phase (except as noted). A detailed narrative description of each phase is as follows:

PHASE 1 (Main Public Entrance, New Water Line, Parking, Asbestos Abatement, and Covered Walkway): Upon the receipt of the Notice to Proceed and prior to the start of Phase 3, the contractor shall start and complete all contractual work involved in Phase 1 areas; including all temporary signage to direct traffic flow, main public entrance, parking, and asbestos abatement in the pipe basement, the installation of the new water line as noted on the contract drawing and the covered walkway.

PHASE 2 (Chiller Building and Portion of the Site Work): Upon receipt of the Notice to Proceed, the contractor shall start and complete all contractual work involved in Phase 2 areas, including the chiller building, site utilities, roads, parking, walkways, and landscaping with the following construction restraints:

- a. This must be completed no later than the completion of Phase 3.
- b. The new water line as noted on the contract drawing shall be accomplished during Phase 1.

PHASE 3 (New Outpatient/Clinical Addition): Upon completion of Phase 1 areas and prior to the start of Phase 4, the contractor shall start and complete all contractual work involved in Phase 3 with the following construction restraints:

- a. The wall penetrations on the first and second floors of the existing Building 1, between Column Lines 11 and 12, shall be accomplished during this Phase 3.
- b. The wall penetration on the second floor of the existing Building 1, east of Column Line 8, shall be accomplished during Phase 4.
- c. The wall penetration on the second floor of the existing Building 1, west of Column Line 15, shall be accomplished during Phase 5.
- d. The contractor shall provide temporary dust partitions (coordinate with Resident Engineer) on all of the above wall penetrations, to separate the construction areas from the VA occupied areas.
- e. This work must be closely coordinated with the Phase 2 activities.

EXHIBIT I.6

PHASE 4 (Pipe Basement, First and Second Fl : Upon completion of Phases 2 and 3, the VA will have fourteen (14) calendar days to move, then release Phase 4 areas to the contractor. The contractor shall then start and complete all contractual work involved in Phase 4.

PHASE 5 (Pipe Basement, First and Second Floor West Wing): Upon completion of Phase 4, the VA will have fourteen (14) calendar days to move, then release Phase 5 areas to the contractor. The contractor shall then start and complete all contractual work involved in Phase 5 areas.

SPECIAL PHASING REQUIREMENTS

a. Contractor shall construct dust partitions prior to the start of demolition and they must remain in place until the completion of that phase or subsequent phases where required.

b. Contractor shall perform all work in or adjacent to VA occupied areas in such a manner to ensure:

- 1) The continuous and uninterrupted use of all occupied areas, including the applicable mechanical and electrical systems serving these areas.
- 2) Protection of patients and personnel in occupied areas from the hazards and dust associated with a construction environment.
- 3) The work areas are to be kept clear, clean, and free of loose debris, construction materials and partially installed work which would create a safe hazard or interfere with patient and personnel duties and traffic. The contractor shall sweep the areas clean at the end of each work day and make every effort to keep dust and noise to a minimum at all times.

c. Temporary interruptions or shutdown of any utility or electrical/mechanical system should be requested from the R/E 48 hours prior to the desired time, and should be performed at times other than the station's normal hours of operation or as directed by the R/E.

d. Two weeks (14 calendar days) prior to starting work in any phase the contractor shall notify the R/E, in writing, of date he plans to complete the preceding phase. In no case will be contractor begin work in any phase without obtaining written approval from the R/E.

e. The sequence of work and durations as shown on the phasing diagram on Drawing CPM-___ are contractual and the contractor must complete all in each phase with the VA inspecting and accepting the work, prior to the contractor proceeding to the next scheduled phase.

f. The sample CPM Network Drawings CPM-1 is for the contractor's information. The sample network indicates the level of detail and technique which will be required on the contractor's network and described in the NAS Section of the Specifications. The CPM notes and legend on Drawing CPM-1 are contractual.

EXHIBIT I.6

STANDARDIZED DEFINITIONS:

JOINT OCCUPANCY - Those area(s) designated as being jointly occupied means that the contractor will be able to complete the work necessary in the building(s), room(s), or area(s) designated in particular phase, while remaining occupied by the VA personnel and/or patients. The contractor shall, in all jointly occupied area(s), protect VA personnel/patients and existing equipment from the hazards of dust, materials, tools, etc., associated with a construction environment. The contractor shall keep these jointly occupied area(s) clear, clean, and free of loose debris, construction materials and partially installed work which would create a safety hazard or interfere with VA personnel or patients. The contractor will pay particular attention to leaving these jointly occupied area(s) clean at the end of each work shift.

VACATED AREA(S) - Those area(s) designated as being vacated area(s) means that the contractor will be able to complete the work necessary in the building(s), room(s), or area(s) designated in a particular phase, without the presence of VA personnel and/or patients. In equipment from the hazards of dust, materials, tools, etc., associated with a construction environment; however, the contractor will be required to observe any restraint(s) outlined under the "Special Phasing Requirements", section 01010, of the Contract Specifications.

ROOM BY ROOM BASIS - Those area (s) designated as being completed on a room by room basis means that the contractor will be allowed to complete the work necessary in that room, whether the particular room is a 'jointly occupied area' or a 'vacated area', and that all work in that particular room must be completed in full and accepted by the VA prior to starting work in another room so designated in that particular phase. The contractor will observe those phasing restraint(s) outlined and pertaining to 'jointly occupied' areas or 'vacated area' under Section 01010 of the Contract Specifications.

AFTER NORMAL WORKING HOURS - Those area(s) designated as being worked after normal working hours means that the contractor will be able to perform the work necessary in the building(s), room(s), or area(s) designated in a particular phase, only during the hours that the VA considers to be other than their normal hours. Normal hours are 8:00 am to 4:30 PM. The contractor must allow enough time at the end of each shift to clean and return the area(s) back to the station prior to the start of the station's normal hours of operation. Existing equipment in the area(s) shall be protected from the hazards of dust, materials, tools, etc., associated with a construction restraint(s) as outlined and pertaining to these area(s), under the "Special Phasing Requirements", Section 01010, of the Contract Specifications.

EXHIBIT I.6

PHASING PLAN

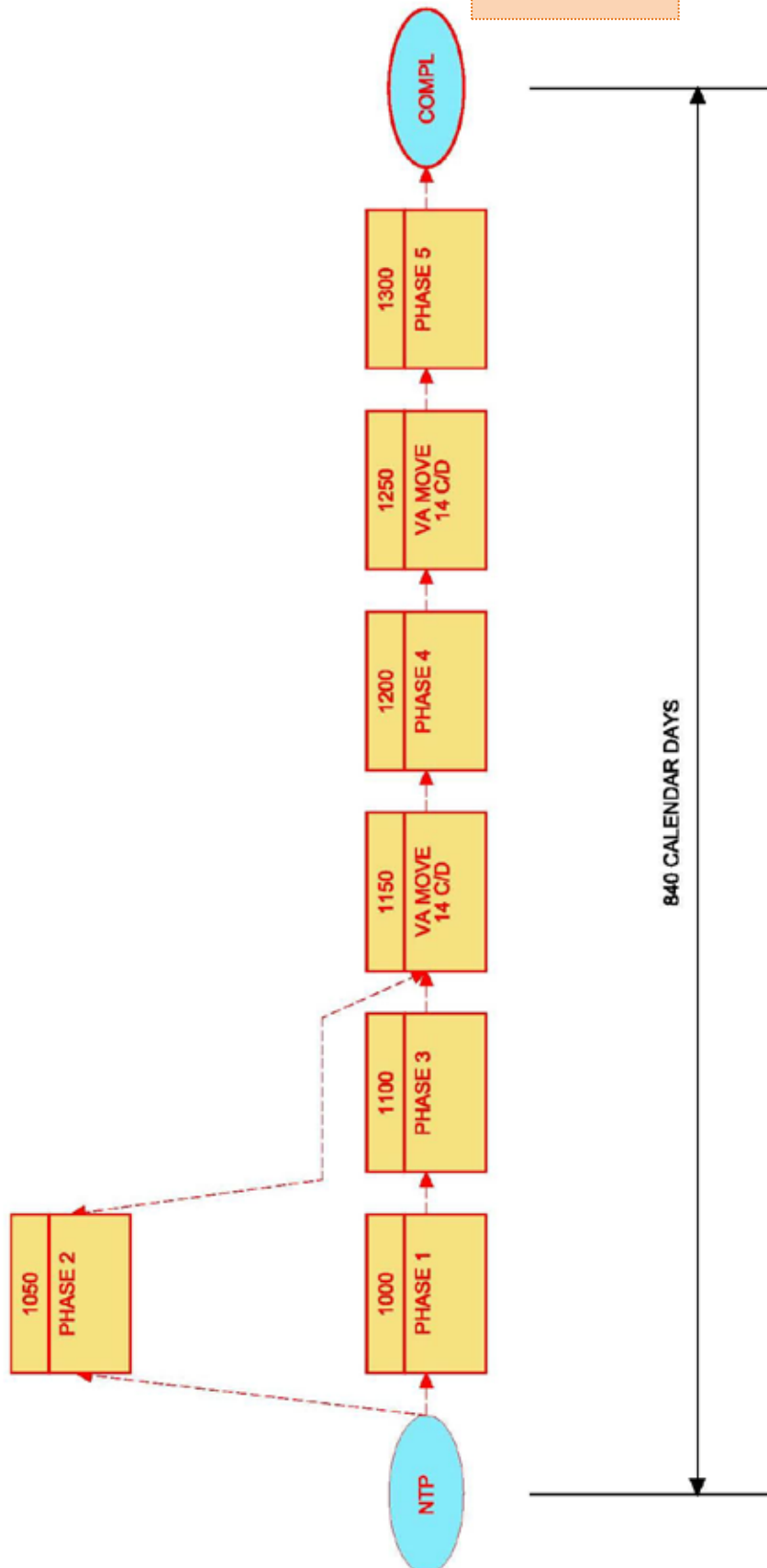


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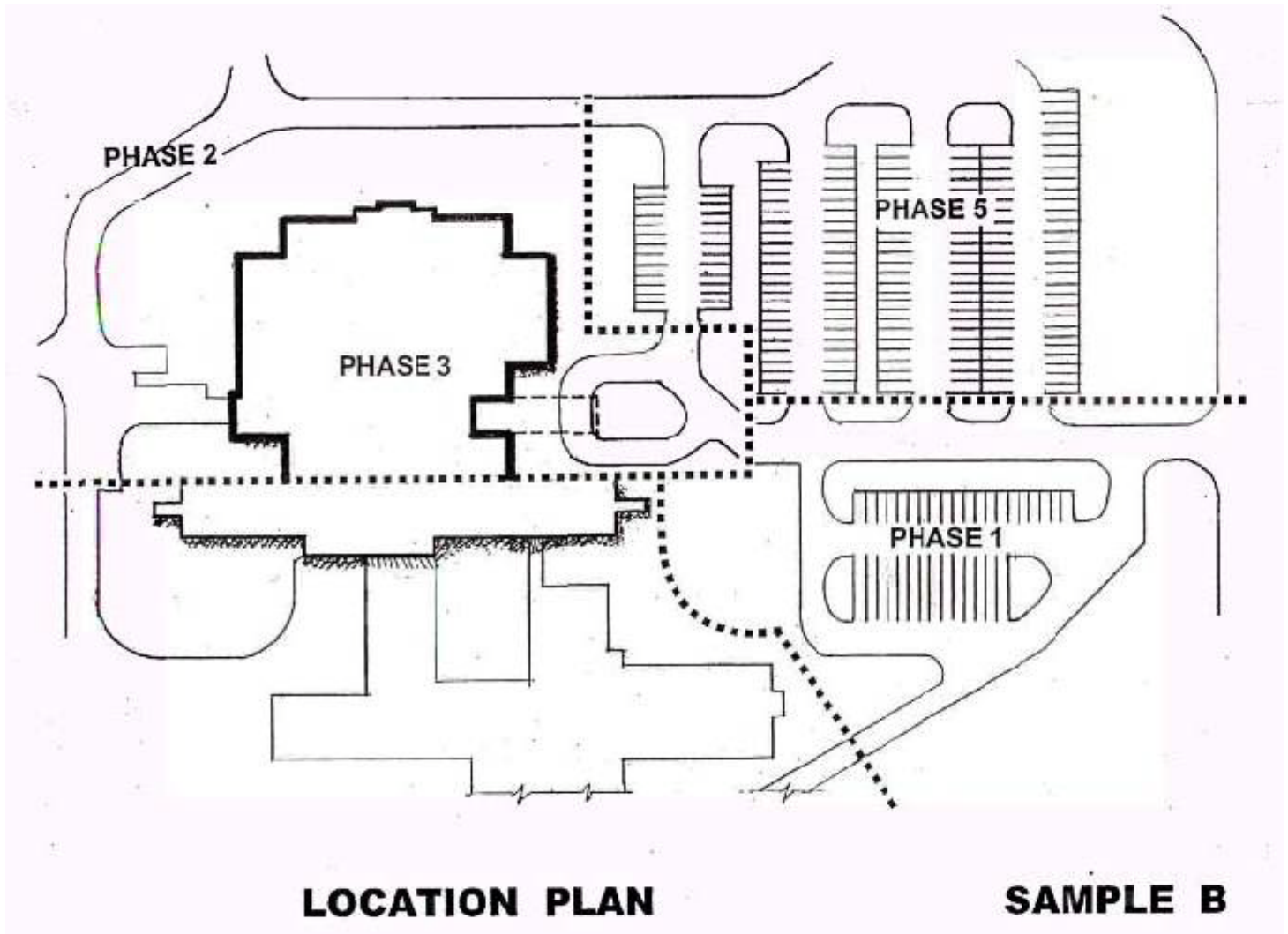


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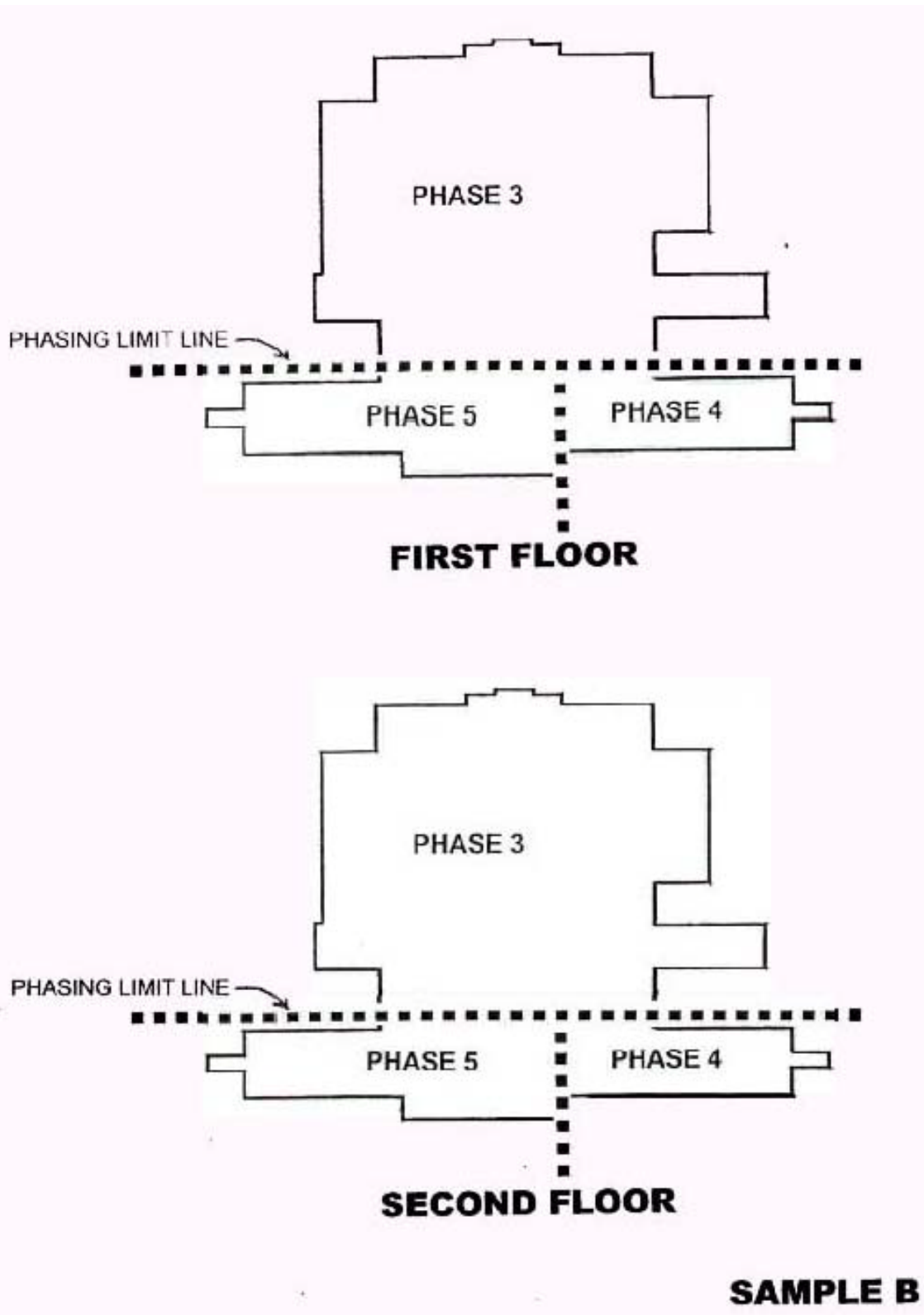


EXHIBIT I.7

Cost Projection S-Curve for a Typical Design Phase in VAMC Project



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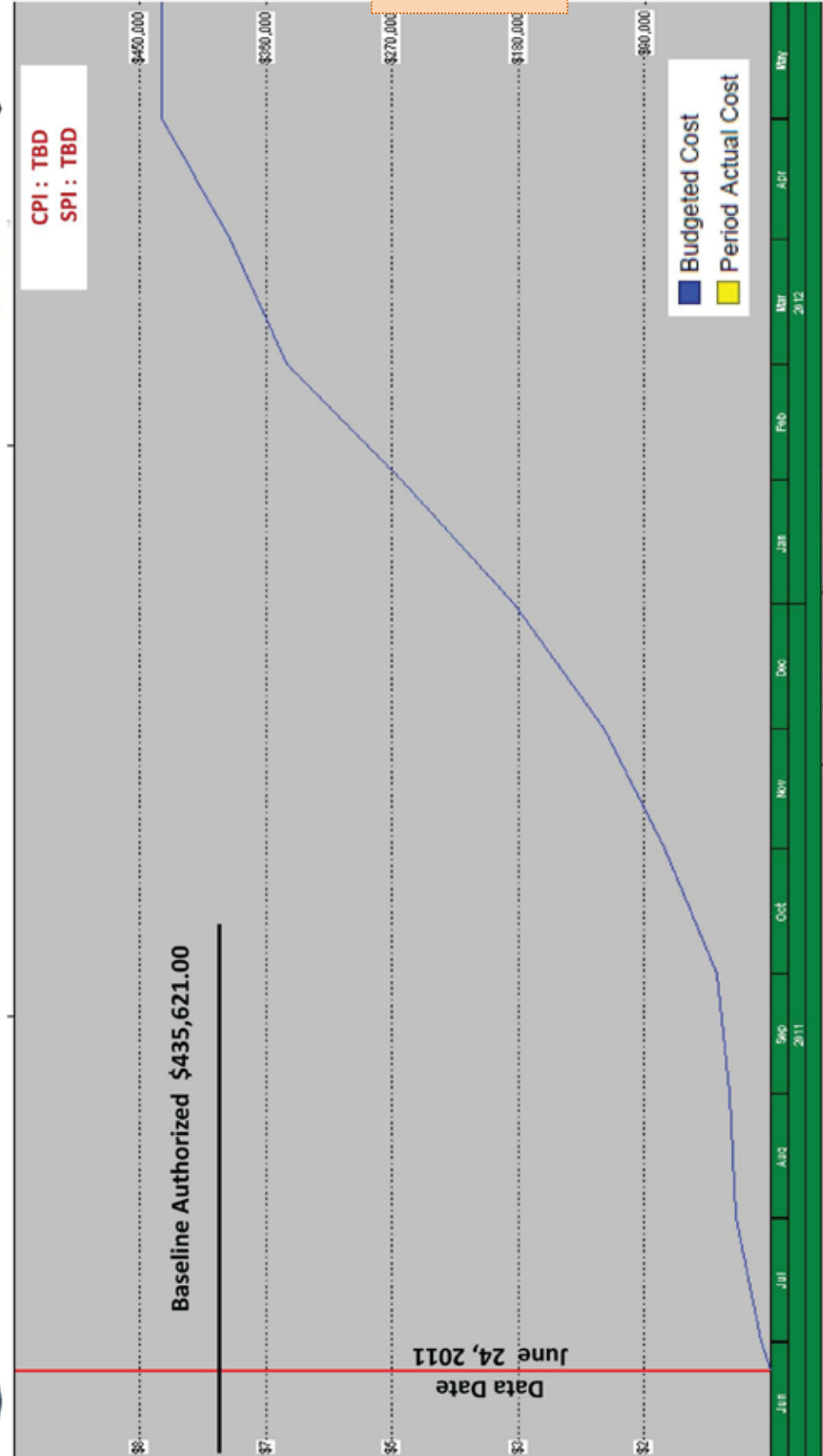


EXHIBIT I.8

SAMPLE OUTLINE FOR A NARATIVE REPORT

Progress of Contract Work

In this section, the A/E will provide in narrative format the current progress of the contract work

Description of Work Accomplished per period

In this section the A/E will discuss in detail the overall scope of work and the phase of work and the work accomplished during each update period

Comparison of Actual Work Progress versus Schedule

In this section, the A/E will describe in detail the comparison between the actual progresses against what was planned.

Shop Drawing Preparation and Review Status

In this section, the A/E will discuss in detail the preparation and review status of any shop drawings that may adversely impact the completion of the design phase

Changes or Additions to Scope

In this section, the A/E will provide a detail explanation of any changes or additions to the original scope and how they are impacting the overall schedule.

Detail Time Impact Analysis must be supported by CPM data at the time the event in question occurs.

Causes of Delays

In this section, the A/E will discuss in details all causes of delays and potential delays to the design phase of the project

Changes in Logic, Sequence, Durations, or Activities and Reasons Therein

In this section, the A/E will include in detail all changes in logic, sequence, durations, or activities as it relates to the design activities contained in the detailed design schedule

Actions Proposed to Restore Schedule

In this section, the A/E will provide in detail, actions that will be taken to restore the design schedule in the instance where there is a delay.

Problems or Changes Anticipated or Expected

In this section, the A/E will itemize in minute detail, the problems or changes anticipated during each design schedule update. This will help in circumventing potential delays.

Changes in Payment Schedule

In this section, the A/E will explain in detail the changes in payment schedule during each design schedule update

Explanation for Out of Sequence Activities

In this section, the A/E will provide a detailed explanation of out of sequence design activities during each schedule update.

EXHIBIT I.9

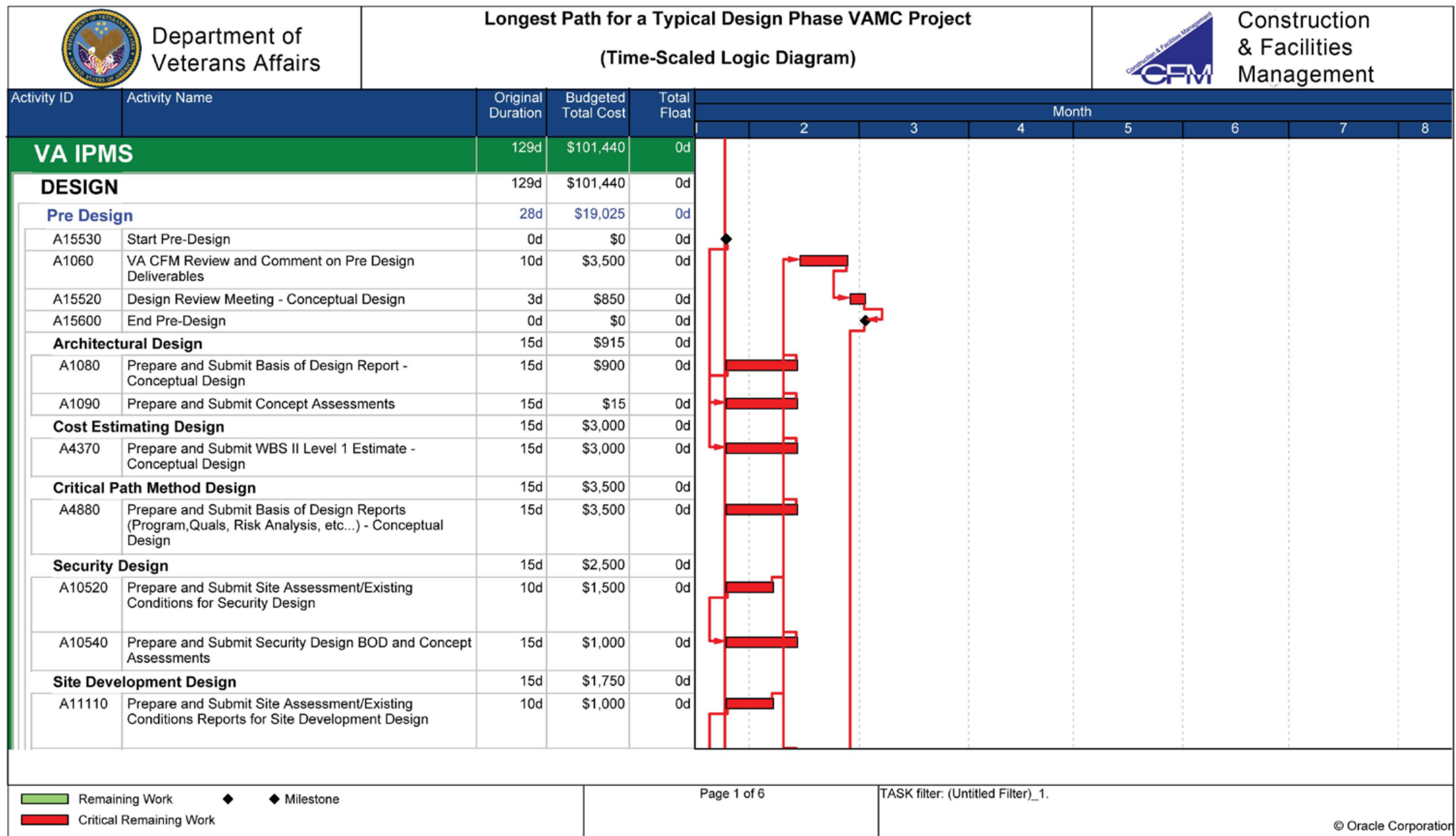


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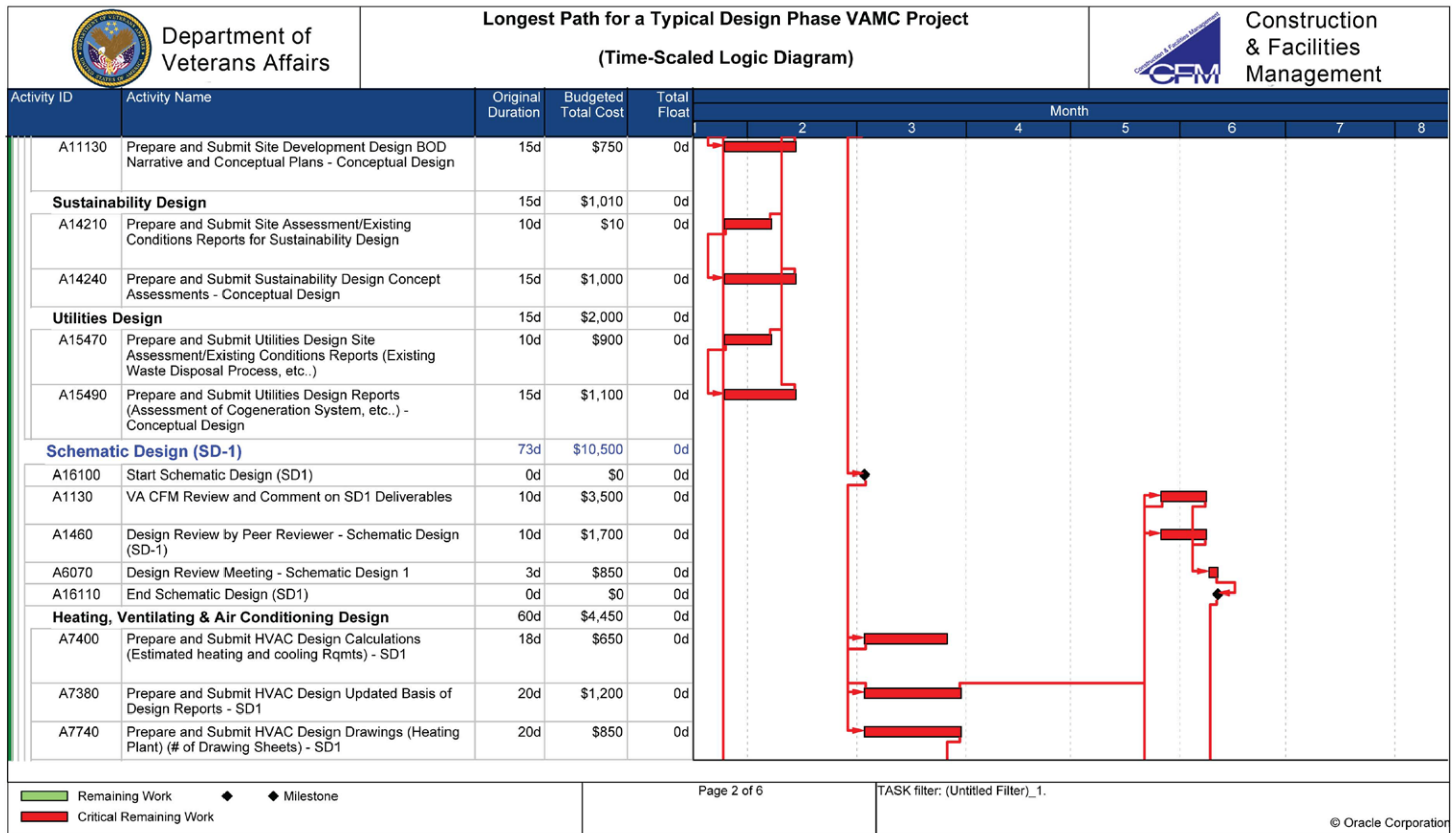


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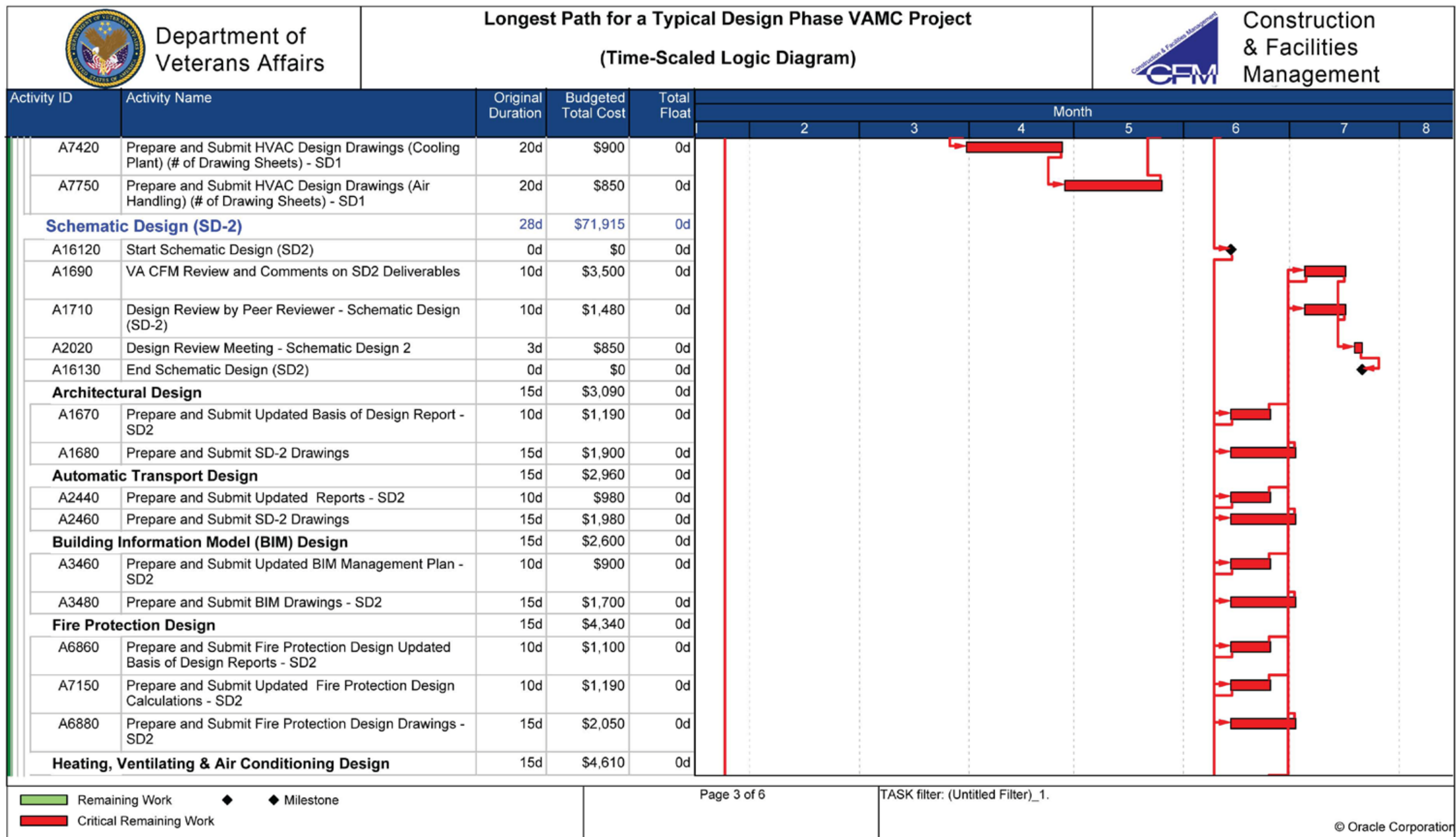


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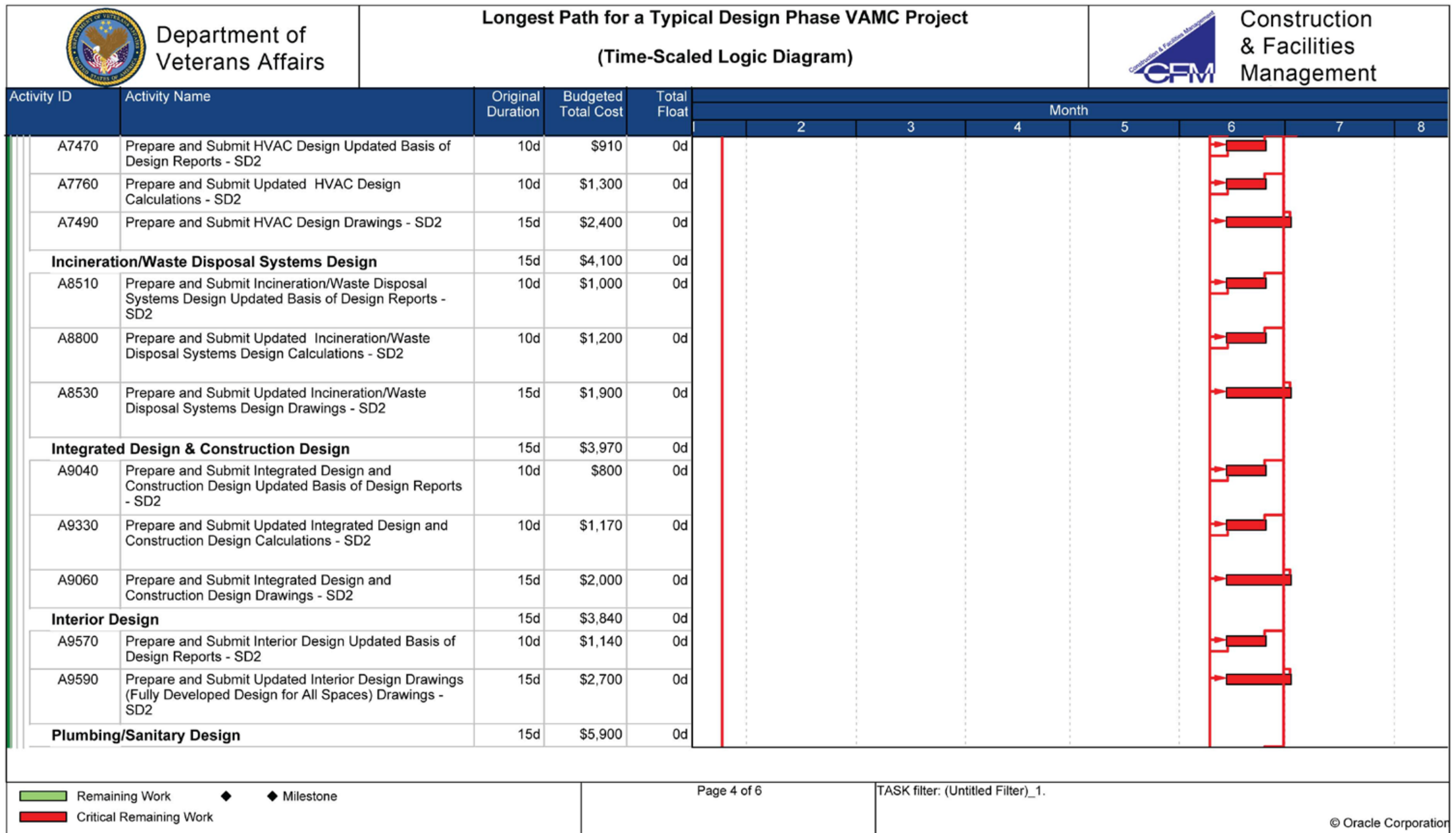


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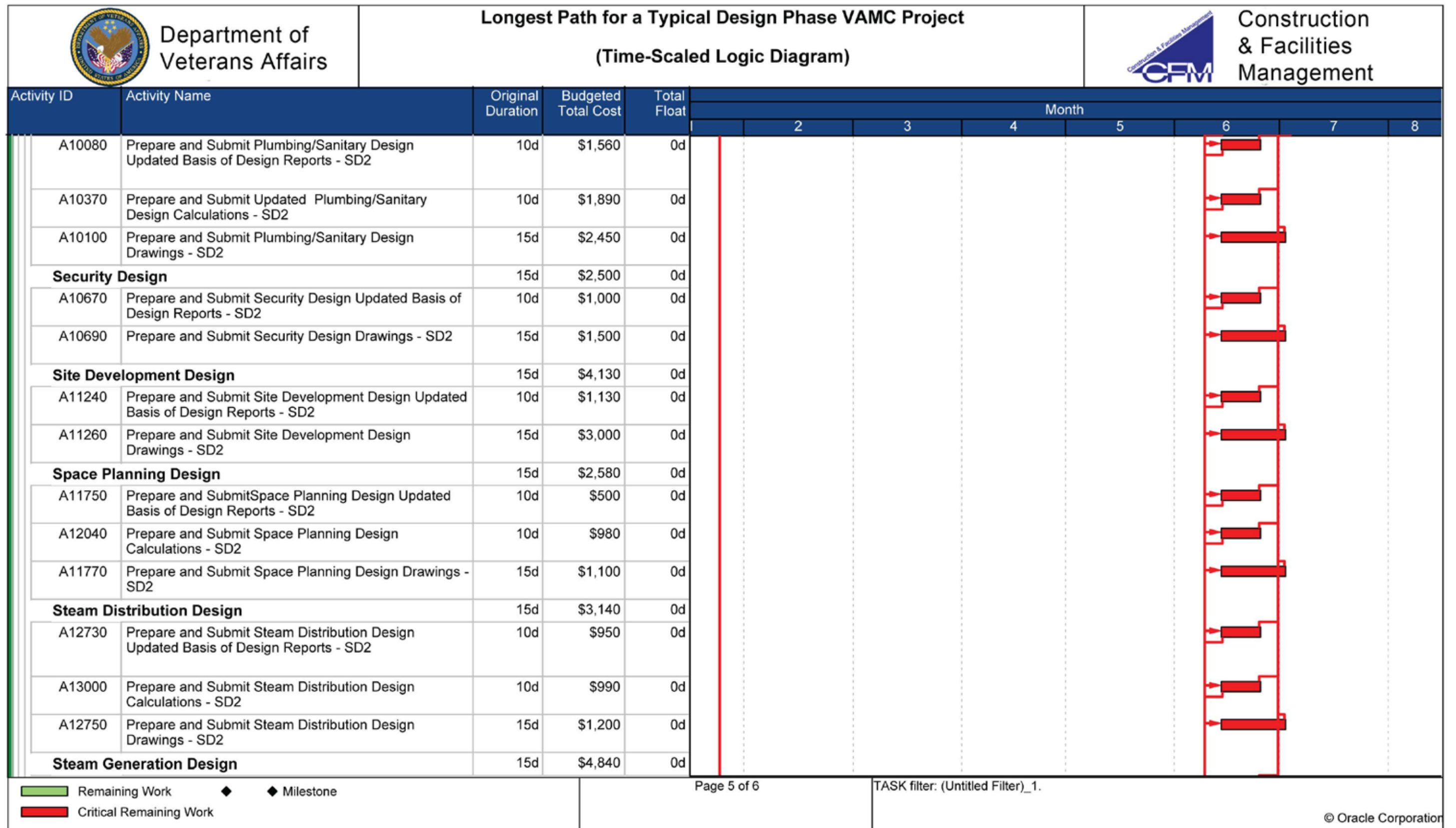


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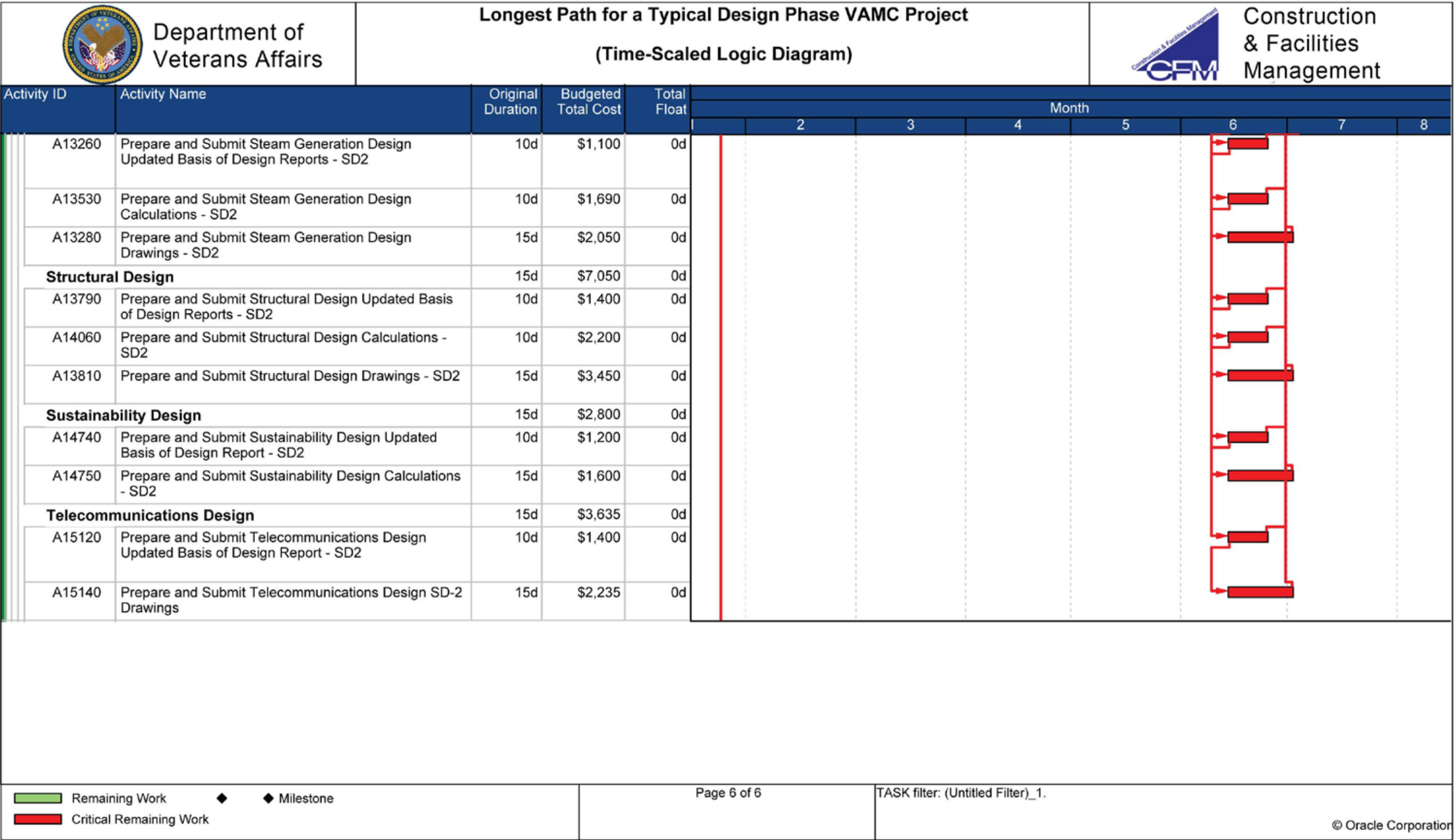


EXHIBIT I.10

