Communications Reliability for Vehicle Grid Integration

CHARGEX consortium

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List of Acronyms

AC	alternating current
CSMS	charging station management system
DC	direct current
DER	distributed energy resource
DERMS	distributed energy resource management system
DR	demand response
ESDP	extensible SECC discovery protocol
EV	electric vehicle
EVCC	electric vehicle communications controller
EVSE	electric vehicle supply equipment
OCPP	Open Charge Point Protocol
OEM	original equipment manufacturer
PFMEA	process failure mode and effects analysis
PWM	pulse-width modulation
SCM	smart charge management
SDP	SECC discovery protocol
SECC	supply equipment communications controller
SEMS	site energy management system
SOC	state of charge
V2G	vehicle-to-grid

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1 Introduction

As electrical vehicle sales have increased in the United States, additional charging stations are needed to support a growing fleet. These include faster direct-current (DC) chargers and slower Level 1 and Level 2 alternating-current (AC) chargers. This increase in demand for electricity is further exacerbated by recent developments in artificial intelligence technology, advanced manufacturing, and digitization. These factors will require electric utilities to upgrade their infrastructure to keep up with the increasing electrical demand (especially during peak hours). An easy way to counteract the need for these upgrades is to shift a major chunk of active charge sessions (durations where there is energy transfer from a charger to an EV's propulsion battery) to off-peak hours, thereby flattening the load curve and making the infrastructure more resilient. This concept is known as smart charge management (SCM). EV owners also benefit from SCM because it lowers their charging costs and consequently their transportation costs by prioritizing charging during off-peak hours. SCM takes advantage of an EV's capability to act as a controllable load or distributed energy resource (DER).

This report summarizes the reliability analysis performed on the communication required for two of these SCM use cases. This analysis only focuses on SCM strategies for unidirectional charging (energy transfer from electric vehicle supply equipment [EVSE] to an EV, also known as V1G), and not bidirectional power transfer (V2G).

1.1 Motivation

SCM inherently involves multiple stakeholders apart from just the EV and charging station (i.e., EVSE). These typically include the electric utility, charging station management system (CSMS), and distributed energy resource management system (DERMS), to name a few. Currently there are a few real-world SCM implementations that primarily use API calls proprietary to EV original equipment manufacturers (OEMs) to facilitate the necessary information exchange.

Alternatively, SCM strategies can also be executed using a set of existing open/publicly available communication standards or protocols that can cater to the same information exchange. However, there are many variations of each of these protocols, and each combination of these protocols comes with its own advantages and disadvantages. Due to the complexity involved and other factors, these are yet to be adopted across all the relevant SCM stakeholders.

Thus, this report aims to address reliability issues related to the communication interfaces associated with executing SCM at scale, which is currently an under-researched area. The reliability analysis is performed on two SCM use cases, one for proprietary communication and one for open communication protocols.

1.2 Intended Audience

Apart from the outcomes of the communication reliability analysis, this report also describes the framework used to analyze the same for two SCM use cases. We chose the two use cases to maximize the number of applicable SCM stakeholders and the communication methods

involved. This reliability analysis is generic from a communications architecture perspective and intentionally agnostic to SCM strategies. This enables the presented analysis framework to be easily modified by any SCM stakeholder in the EV charging industry for their own application.

1.3 Methodology

The work presented in this report began by identifying two SCM use cases for analysis. The methodology used to analyze communications reliability for these comprises the following three stages:

- **Communications architecture:** This stage includes identifying all required stakeholders in the SCM use case and the typical communication interface between each pair of stakeholders that require information exchange.
- **Sequence diagram:** This stage involves formalizing the information exchange between the various stakeholders and internal processes necessary for proper execution of SCM. This builds off the complementary work on "EV Charging Sequence Diagrams and State Machines" for vehicle-grid integration led by Jason Harper (Argonne National Laboratory),[1] which captures the sequence diagrams for various combinations of communication protocols.
- **Communications reliability:** The final stage involves using a modified version of the process failure mode and effects analysis (PFMEA) framework. Due to the nascent stages of SCM adoption (as detailed in Section 1.1), a stripped back version of the typical PFMEA framework is used to perform the reliability analysis. Failure modes, effects, and potential causes are identified just like a regular PFMEA, but the reliability analysis framework used for this investigation is limited to assessing only the "severity" and not "occurrence" or "detection." Given the lack of real-world SCM implementation, the occurrence and detection aspects of a normal PFMEA are difficult to estimate. This is because these factors heavily depend on specific communications architecture design and software requirements of all the stakeholders involved. Hence, all mentions of "PFMEA" in this report refer to this stripped back version.

The severity rating used in both use-cases is designed to capture the effects of each fault at the individual stakeholder level and at scale. Because the primary aim is to investigate reliability of SCM functions from a communications perspective, failures related to payment and user errors are not considered.

Additionally, in light of the factors mentioned above, this report is meant to serve as a preliminary analysis of communication reliability in implementing SCM. The analysis presented here is intended to serve as a foundation for more exhaustive reliability analysis.

[1] github.com/chargex-consortium/ev-charge-seq-state.

2 Use Cases

As mentioned in Section 1.2, we chose two SCM use cases to maximize the breadth of applicable SCM stakeholders and the communication methods involved. To ensure this, the criteria used to choose the use cases are:

1. At least one use case should fairly represent a current real-world SCM implementation.
2. The other use case should be more future-looking and represent an "ideal" SCM implementation.
3. At least one use case should use publicly available communication standards and protocols. The charging scenario investigated for this use case should at least include the core functionalities enabled by fully implementing the involved standards.
4. At least one use case should be based on proprietary (not publicly available) communications.

In addition to the above criteria, we also incorporated industry input to identify use cases, design the charging scenarios, and perform the reliability analysis using a condensed PFMEA framework. The following subsections present a detailed description of the use cases identified and the reliability analysis.

2.1 Use Case 1: Telematics-Based Scheduled Charging

In this SCM use case, an EV owner/driver can opt into a managed charging program with a third-party aggregator or DERMS. By opting in, they allow the DERMS to shift their charge sessions to off-peak hours, thereby minimizing charging costs. This use case satisfies Criteria 1 and 4.

2.1.1 Communications Architecture

Figure 1 shows the communications architecture used to perform the SCM reliability analysis. EV-to-EVSE communication is based on pulse-width modulation (PWM) (SAE J1772). EVs communicate with their OEM telematics platform via 4G/5G connection. The aggregator/DERMS platform exchanges information with each partner EV OEM's telematics platform via API calls. This includes information like vehicle status, charge status, and charge session details. EV owners/drivers opt in to the managed charging program via an app, which the DERMS also uses to ingest information about user preferences. Finally, the DERMS platform and utility have an established communications channel for exchanging information like tariff details and demand-response (DR) events depending on the services offered by the DERMS. All communications except those between the EV and EVSE are not based on publicly available standards. The DERMS manages charging of registered EVs from multiple OEMs and thus polls data via API calls from multiple OEM telematics platforms.

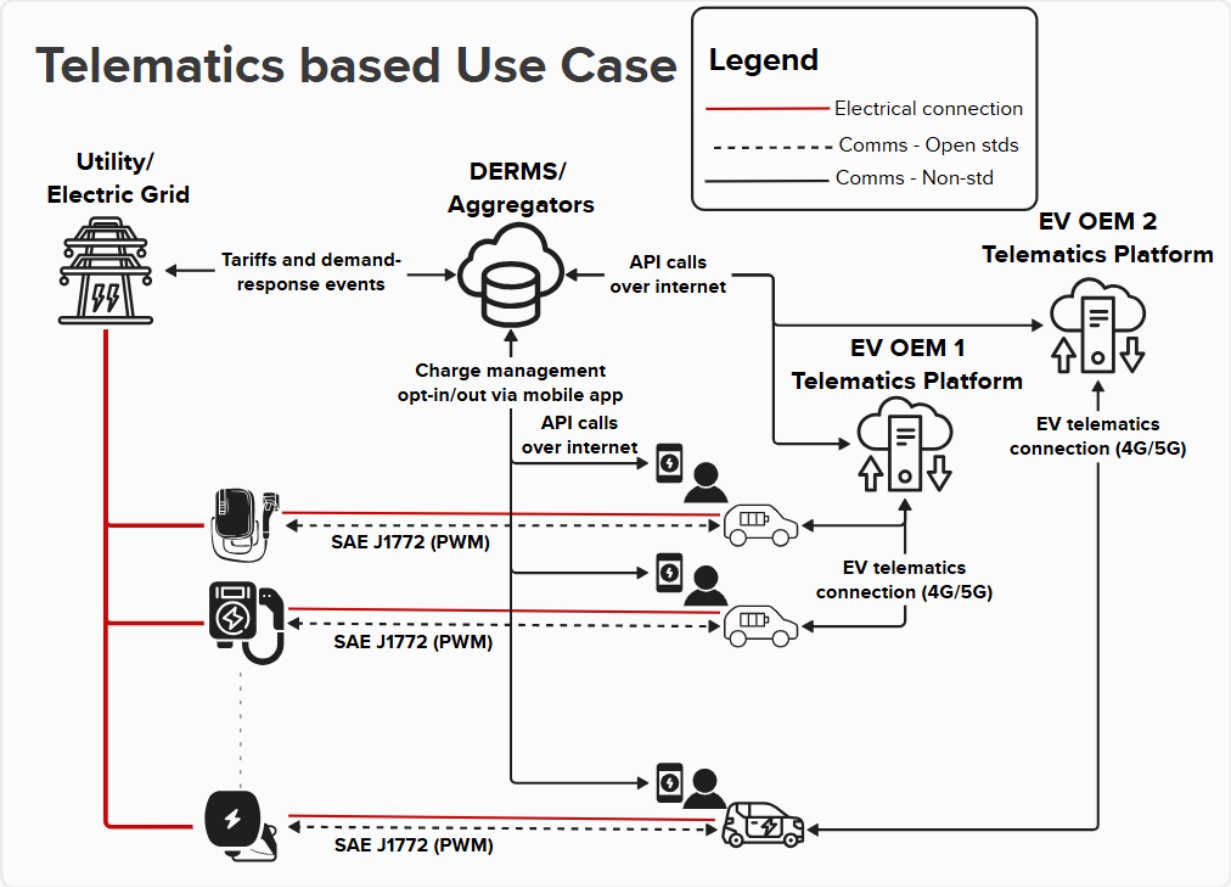


Figure 1. Communications architecture, Use Case 1

2.1.2 Sequence Diagram

Figure 2 shows a snippet of the sequence of information exchange required for proper execution of managed charging. Each communication step is assigned a sequence number, which is used to create the PFMEA table in the next stage. The information being exchanged in each step is detailed in the diagram.

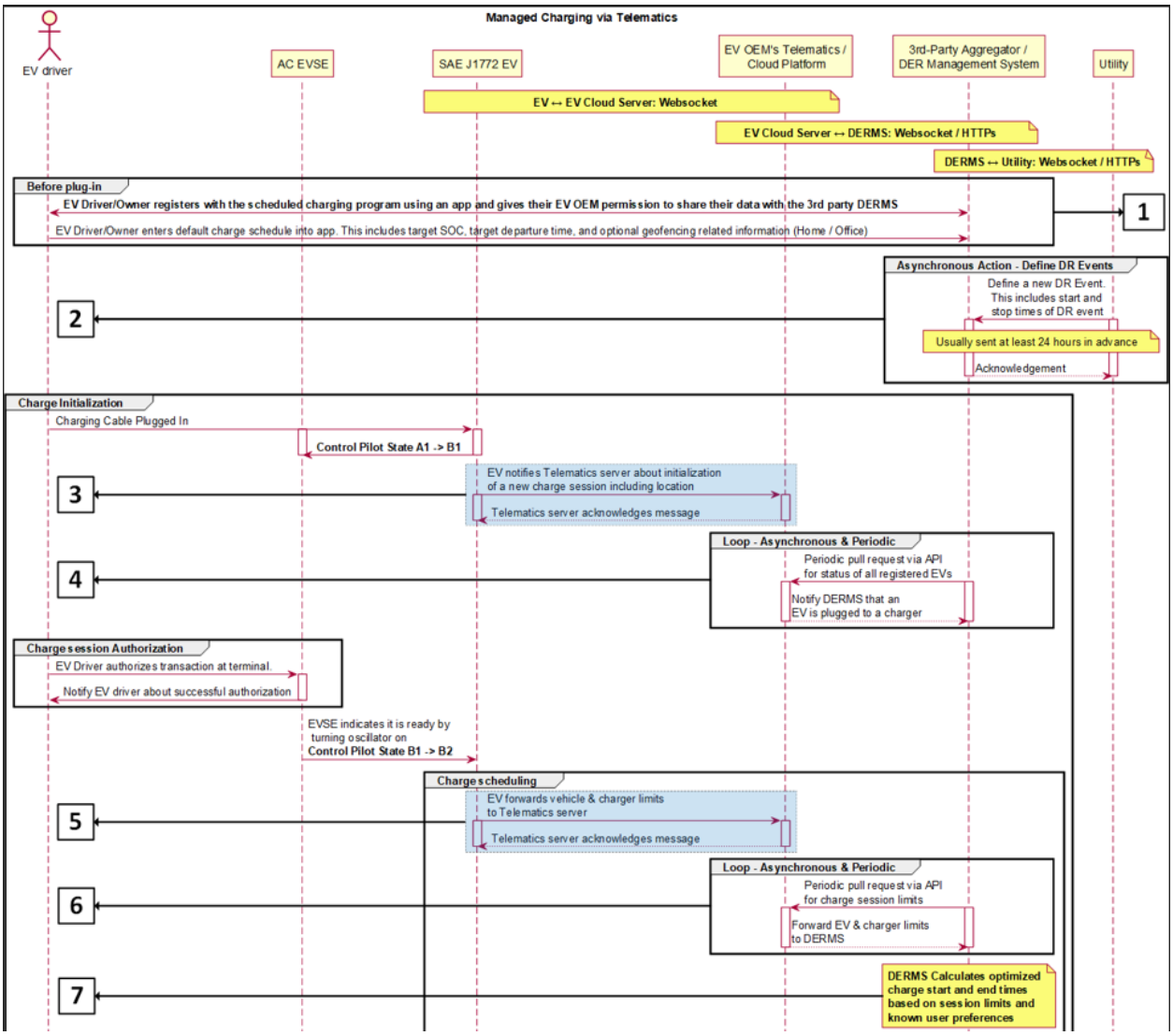


Figure 2. Snippet of sequence diagram, Use Case 1

The full sequence diagram for this use case can be found in Appendix A. The source files can also be found in a publicly available GitHub repository.[2] These can be easily modified to specific implementations of communication interfaces, use cases, and SCM algorithms.

2.1.3 Reliability Analysis

Figure 3 shows a snippet of the PFMEA table used to perform the communications reliability analysis. As explained in Section 1.3, the PFMEA-style analysis stops at assessing severity of the failure. The potential causes of failure identified here are not exhaustive and are meant to serve as an example because this is extremely sensitive to the software requirements and interface definitions of all the stakeholders involved.

[2] github.com/chargex-consortium/Comms-Reliability.

The PFMEA table including all the faults and failure modes identified for this use case can be found in Appendix B. The file can also be found in a publicly available GitHub repository.[3] This can be easily modified to specific implementations of communication interfaces, use cases, and SCM algorithms.

ID	Sequence Number	Process Step / Function	Potential Failure Modes	Potential Effects of failure	Severity of Failure	Potential Cause of Failure
122	5	EV forwards vehicle and charger limits for the session to the telematics server	EV and telematics server cannot reliably communicate with each other	Owner/Driver is charged with the same cost as no managed charging	5	Unstable connection / communication loss
123	5	EV forwards vehicle and charger limits for the session to the telematics server	EV and telematics server cannot reliably communicate with each other	Owner/Driver is charged with the same cost as no managed charging	5	Network congestion
124	5	EV forwards vehicle and charger limits for the session to the telematics server	EV and telematics server cannot reliably communicate with each other	Owner/Driver is charged with the same cost as no managed charging	5	Telematics server downtime
125	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner's/Driver's needs are not met, higher than actual vehicle limits are received	8	Internal failure within EV, encoding issues
126	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner's/Driver's needs are not met, higher than actual vehicle limits are received	8	Telematics server processing issue, decoding issues
127	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner's/Driver's needs are not met, higher than actual vehicle limits are received	8	Data packet loss / corruption
128	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner's/Driver's needs are not met, higher than actual vehicle limits are received	8	Data ingestion error
129	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner/Driver is charged higher than optimal cost for the charge session (One session only), lower than actual vehicle limits are received	1	Internal failure within EV, encoding issues
130	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner/Driver is charged higher than optimal cost for the charge session (One session only), lower than actual vehicle limits are received	1	Telematics server processing issue, decoding issues
131	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner/Driver is charged higher than optimal cost for the charge session (One session only), lower than actual vehicle limits are received	1	Data packet loss / corruption
132	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner/Driver is charged higher than optimal cost for the charge session (One session only), lower than actual vehicle limits are received	1	Data ingestion error
133	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session / EV internally	Owner's/Driver's needs are not met, higher than actual limits are received	8	Internal failure within EV, encoding issues
134	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session / EV internally	Owner's/Driver's needs are not met, higher than actual limits are received	8	Telematics server processing issue, decoding issues
135	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session / EV internally	Owner's/Driver's needs are not met, higher than actual limits are received	8	Data packet loss / corruption
136	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session / EV internally	Owner's/Driver's needs are not met, higher than actual limits are received	8	Data ingestion error
137	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session / EV internally	Owner/Driver is charged higher than optimal cost for the charge session (One session only), lower than actual limits are received	1	Intermittent internal failure within EV, encoding issues

Figure 3. Snippet of PFMEA table, Use Case 1

Figure 4 shows the severity rating definitions for this analysis. In contrast to typical severity rating definitions for a PFMEA, which are usually from the perspective of the primary stakeholder performing the PFMEA, the ratings here are defined with the EV owner/driver, DERMS, and utilities in mind. These can be adopted and modified by any of the EV charging stakeholders to better suit their own application.

[3] github.com/chargex-consortium/Comms-Reliability.

Severity Rating	Failure Effect description
10	EV is inoperable
9	Charging session cannot be shifted to off-peak hours (All EVs)
8	Owner's/Driver's needs are not met
7	Charging session cannot be shifted to off-peak hours (Multiple EVs) **OR** DERMS reports inaccurate charge summary to Utility
6	Owner/Driver is charged higher than optimal cost for the charge session (Multiple EVs)
5	Owner/Driver is charged with the same cost as no managed charging **OR** DERMS cannot accurately track and report successful shift in charging times (Multiple EVs)
4	Owner/Driver is charged higher than optimal cost for the charge session (One/Two EVs)
3	Charging session cannot be shifted to off-peak hours (One/Two EVs)
2	DERMS is unable to report successful charging shift (One EV / One sessions only)
1	Owner/Driver is charged higher than optimal cost for the charge session (One/Two sessions only) **OR** Charging session cannot be shifted to off-peak hours (One/Two sessions only)

Figure 4. Severity rating definitions, Use Case 1

2.1.4 Outcomes

This PFMEA analysis reveals that the most severe fault occurs in the scenario where the DERMS asks the EV to delay the charge session. Typically, this requires the EV to go to a "sleep" state to not drain the low-voltage battery. The EV becomes inoperable if it does not properly go to a sleep state, if there is an abnormal level of current draw in the sleep state, or if the EV does not time out in this charging state where it is plugged in but not actively being charged. These failure modes can be easily addressed by having the EV time out and going to sleep when it is plugged in for a certain amount of time without active energy transfer. Furthermore, the EV would also need to reliably "wake up" and start charging at the appropriate time to ensure that the user's charging needs are met.

The second most severe faults are related to scenarios where the charging sessions for all registered EVs cannot be shifted to off-peak hours, resulting in a potentially high peak electrical demand on the utility. The third level of fault severity occurs when the driver's charging needs are not met—i.e., the driver comes back to their EV only to realize that the traction battery has not been charged at all. The most significant failure modes contributing to both these faults are communications between the DERMS and utility, DERMS and telematics server, and EV and telematics server, as well as internal processing issues at any of these stakeholders. These failure modes can be addressed by improving the bandwidth of these communication channels and by implementing fallback mechanisms on the DERMS, telematics server, and EV with default behaviors to minimize the effects of these failures.

Other less severe but significant causes of failures include API errors and inaccuracies in meter values reported by EVs. The latter can be solved by EV OEMs upgrading to revenue-grade meters and by combining these measurements with smart estimation algorithms to accurately report energy added. API issues are further exacerbated by the varied capabilities and implementation specific to each EV OEM leading to interoperability problems. This also adds complexity to data ingestion on the DERMS side, further contributing to reliability concerns.

Thus, a robust set of software requirements for the EV, telematics server, and DERMS would mitigate these most severe faults. This also needs to be augmented by a corresponding set of robust validation plans for the:

1. EV and telematics server.
2. DERMS and telematics server.
3. Full information pipeline of EV, telematics server, and DERMS.

Apart from the above recommendations, the reliability and functionality of this SCM methodology can be also improved by adding the ability to communicate charging rates, limits, and charge schedules instead of simple "charge start," "charge stop," "sleep," and "wake" signals. This will significantly reduce the dependency on active communication and improve robustness of the overall system to things like bandwidth issues, network outages, and downtime.

The newest versions of EV charging-related communications protocols like the International Organization for Standardization's ISO 15118-2 and ISO 15118-20 and, Open Charge Point Protocol (OCPP) 2.0.1 and OCPP 2.1 offer the capability to exchange such information.

2.2 Use Case 2: Day-Ahead Pricing-Based Optimization

In this SCM use case, the EV contains the SCM algorithm to shift charge sessions within a dwell time while optimizing for charging costs. The EV owner/driver can either manually enter their charging preferences in terms of target state of charge (SOC) and departure time, or the EV can "learn" a user's behaviors over time. The EV combines this information with time-of-use rates (either static or the more dynamic real-time prices) to calculate the optimal charging window with the objective of minimizing charging costs. Because both time-of-use rates and real-time prices defined by utilities can be a proxy for peak and off-peak hours, this SCM method also flattens the electrical load on a utility level. This use case satisfies Criteria 2 and 3.

2.2.1 Communications Architecture

Figure 5 shows the communications architecture for this use case. In contrast to Use Case 1, the combination of communication protocols used in this use case allows for the exchange of charge schedules and tariff information. The CSMS communicates with a pricing server or utility server via IEEE 2030.5 on an HTTP connection. The CSMS communicates with charging stations (EVSE) using OCPP 2.0.1 on Websocket. The EV and EVSE communicate with each other during an active charge session using ISO 15118-2. In summary, the CSMS periodically pulls tariff data (day-ahead prices) from the pricing server. The CSMS then relays the location-specific tariff information, typically for a 24-hour window, to the charging station. Finally, the charging station sends the tariff information to an EV when a new charge session is started. The EV uses this information, in addition to known user preferences, to calculate an optimal charge schedule. This is a combination of charge power level and start and stop times for that power.

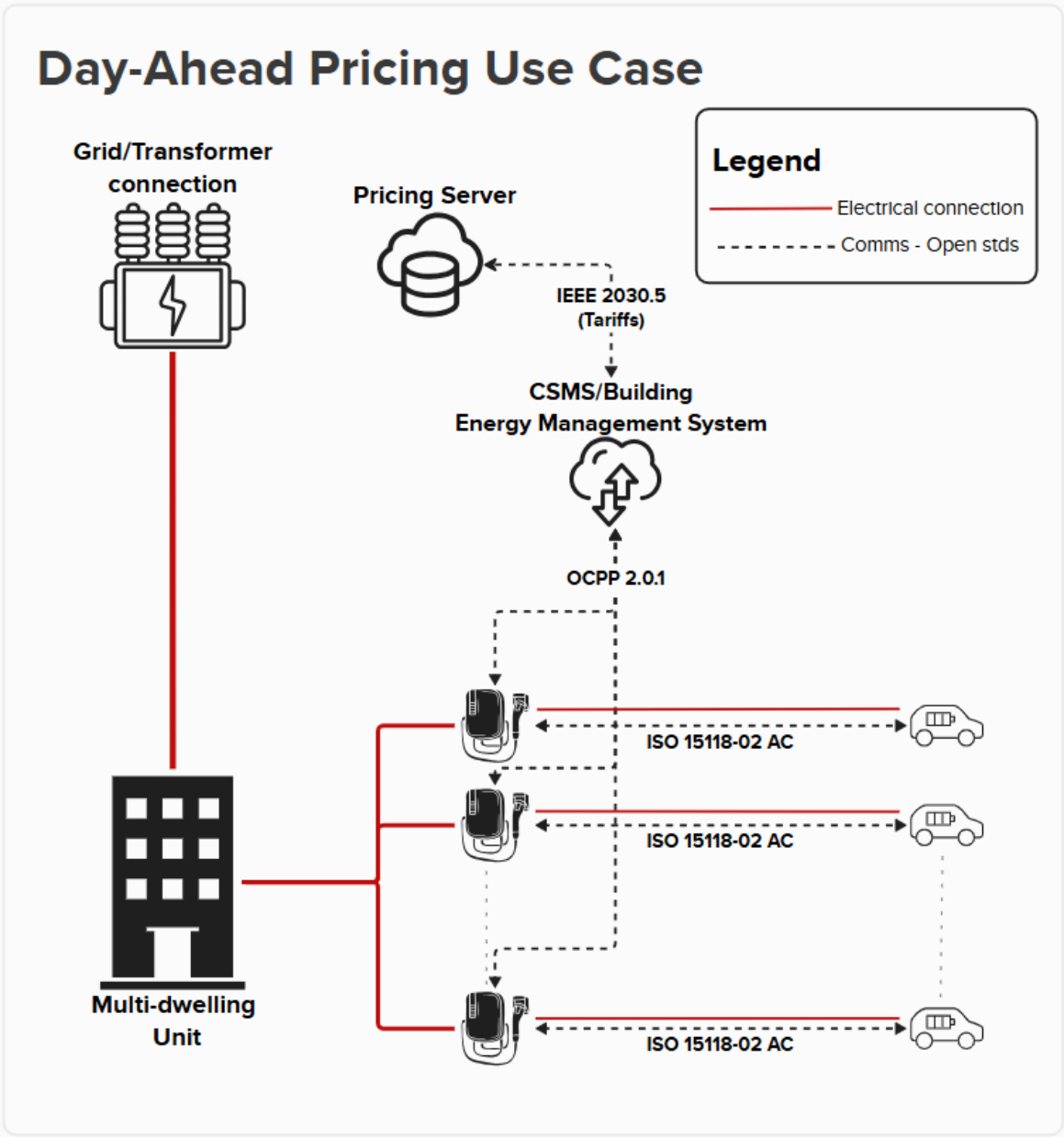


Figure 5. Communications architecture, Use Case 2

2.2.2 Sequence Diagram

Figure 6 shows a snippet of the sequence of information exchange required for proper execution of the SCM strategy for this use case. Each communication step is assigned a sequence number, which is used to create the PFMEA table in the next stage. The information being exchanged in each step and the specific message used to convey that information is detailed in the diagram. For the sake of completeness, due to the different options and possible scenarios based on variables such as user preferences and timing of certain events, the sequence diagram also captures multiple "options." Finally, the sequence diagram also details the mechanism to pause and delay the time where there is active energy transfer during the charge session. This happens

when the optimized charge schedule calculated by the SCM in the EV requires a delayed start to the charge session.

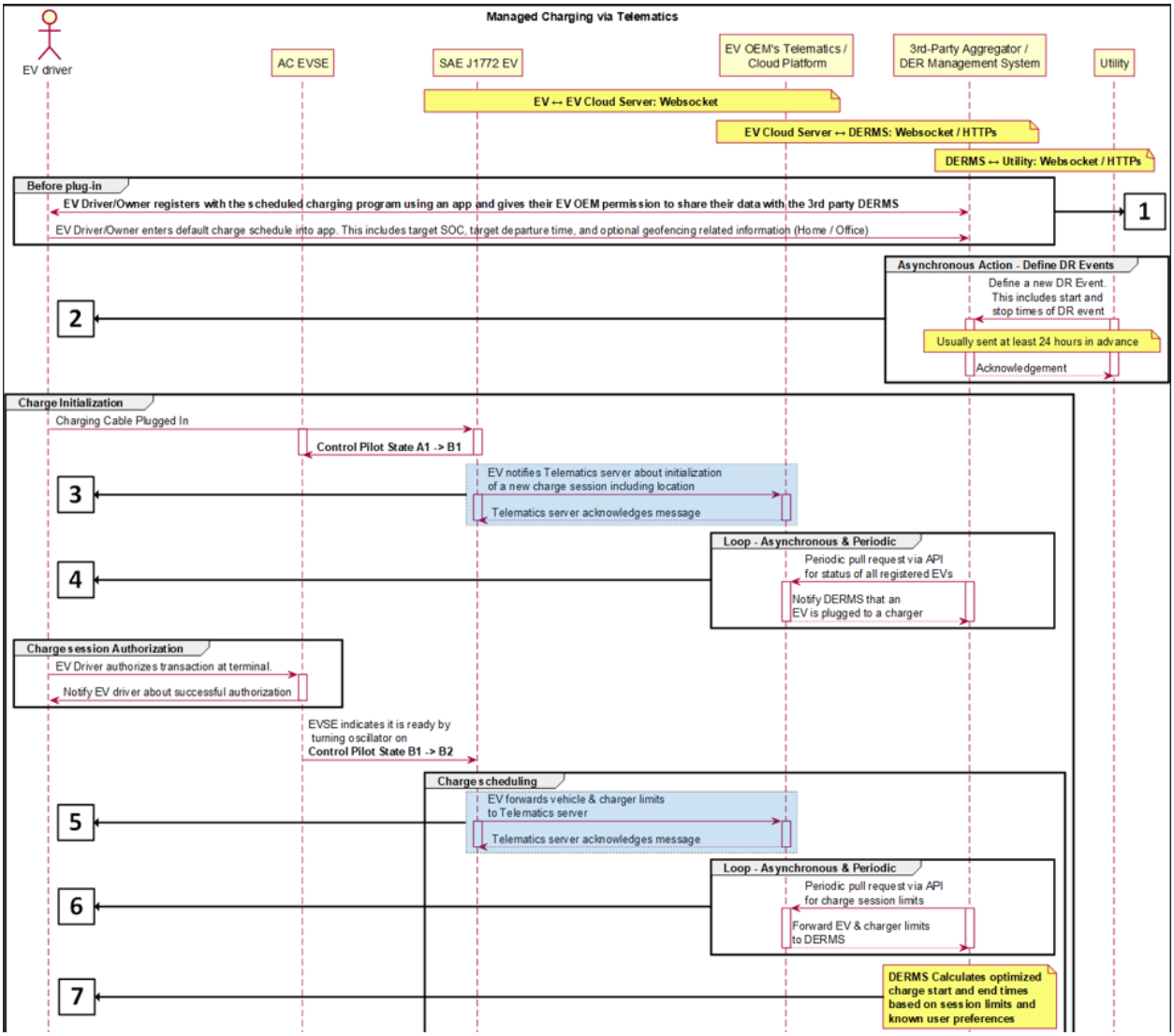


Figure 6. Snippet of sequence diagram, Use Case 2

The full sequence diagram for this use case can be found in Appendix C. The source files can also be found in a publicly available GitHub repository.[4]

2.2.3 Reliability Analysis

Figure 7 shows a snippet of the PFMEA table used to perform the reliability analysis. Similar to the analysis on the first use case, the potential causes of failure identified here are not exhaustive and are meant to serve as an example. In contrast to that analysis, two severity ratings are assigned in this use case: one from a customer perspective, and another from a utility's

[4] github.com/chargex-consortium/Comms-Reliability.

perspective. There are two severity ratings defined for this analysis for each of these two stakeholders, as shown in Figure 8.

The PFMEA table including all the faults and failure modes identified for this use case can be found in Appendix D. The file can also be found in a publicly available GitHub repository.[5] This can be easily modified to specific implementations of communication interfaces, use cases, and SCM algorithms.

ID	Sequence Number	Process Step / Function	Potential Failure Modes	Potential Effects of failure	Customer Severity (S_{Cust})	Utility Severity (S_{Util})	Overall Severity $\left(\frac{S_{Cust}+S_{Util}}{2}\right)$	Potential Cause of Failure
45	3	CSMS forwards tariff information to Charge Station / EVSE	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	6	7	6.5	Internal failure within CSMS, encoding issues
46	3	CSMS forwards tariff information to Charge Station / EVSE	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	6	7	6.5	EVSE processing issue, decoding issues
47	3	CSMS forwards tariff information to Charge Station / EVSE	Inaccurate tariffs	Wrong tariff applied, legal risks	6	5	5.5	Incorrect / Incomplete protocol implementation
48	3	CSMS forwards tariff information to Charge Station / EVSE	Inaccurate tariffs	Wrong tariff applied, legal risks	6	5	5.5	Data packet loss / corruption
49	3	CSMS forwards tariff information to Charge Station / EVSE	Inaccurate tariffs	Wrong tariff applied, legal risks	6	5	5.5	Internal failure within CSMS, encoding issues
50	3	CSMS forwards tariff information to Charge Station / EVSE	Inaccurate tariffs	Wrong tariff applied, legal risks	6	5	5.5	EVSE processing issue, decoding issues
51	4	Initial EV to EVSE communication handshake (Pre V2G session)	EV / EVSE fail to establish a data link commuication session	Failed charge session	8	1	4.5	Faulty hardware (PLC chip inside EV / EVSE)
52	4	Initial EV to EVSE communication handshake (Pre V2G session)	EV / EVSE fail to establish a data link commuication session	Failed charge session	8	1	4.5	Incompatible protocols
53	4	Initial EV to EVSE communication handshake (Pre V2G session)	EV / EVSE fail to establish a data link commuication session	Failed charge session	8	1	4.5	Connector issue
54	4	Initial EV to EVSE communication handshake (Pre V2G session)	EV / EVSE fail to establish a data link commuication session	Failed charge session	8	1	4.5	Signal integrity issue (Noise)
55	4	Initial EV to EVSE communication handshake (Pre V2G session)	EV / EVSE fail to establish a data link commuication session	Failed charge session	8	1	4.5	EVCC firmware crash
56	4	Initial EV to EVSE communication handshake (Pre V2G session)	EV / EVSE fail to establish a data link commuication session	Failed charge session	8	1	4.5	SECC firmware crash
57	5	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	1	4.5	Unstable connection / communication loss
58	5	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session ONLY if EVSE is not configured to charge in offline mode	8	1	4.5	Network congestion
59	5	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session ONLY if EVSE is not configured to charge in offline mode	8	1	4.5	CSMS downtime
60	5	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session ONLY if EVSE is not configured to charge in offline mode	8	1	4.5	Charger firmware crash
61	5	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	CSMS doesn't have accurate information about staus of EVSE & its connector, sequence failure	7	1	4	Incorrect / Incomplete protocol implementation
62	5	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	CSMS doesn't have accurate information about staus of EVSE & its connector, sequence failure	7	1	4	Data packet loss / corruption
63	5	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	CSMS doesn't have accurate information about staus of EVSE & its connector, sequence failure	7	1	4	Internal failure within EVSE firmware, encoding issues
64	5	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	CSMS doesn't have accurate information about staus of EVSE & its connector, sequence failure	7	1	4	CSMS processing issue, decoding issues
65	5	EVSE updates its status to CSMS	Inaccurate evseId / connectorID	CSMS assigns connectorStatus to the wrong EVSE & connector, incorrect availability tracking	6	7	6.5	Incorrect / Incomplete protocol implementation
66	5	EVSE updates its status to CSMS	Inaccurate evseId / connectorID	CSMS assigns connectorStatus to the wrong EVSE & connector, incorrect availability tracking	6	7	6.5	Data packet loss / corruption
67	5	EVSE updates its status to CSMS	Inaccurate evseId / connectorID	CSMS assigns connectorStatus to the wrong EVSE & connector, incorrect availability tracking	6	7	6.5	Internal failure within EVSE firmware, encoding issues

Figure 7. Snippet of PFMEA table, Use Case 2

[5] github.com/chargex-consortium/Comms-Reliability.

Severity Rating	Effect on Customer (S_{Cust})	Effect on Utility (S_{Util})	Severity Rating
10	Electrical safety / grid safety issues making charging point inoperable and potentially damging EV, would affect future customers too	Grid / electrical safety issues	10
9	EV inoperable (HV Battery drain)	Regulatory non-compliance	9
8	Failed charge session, no energy added	Incorrect (Higher) tariffs applied by utility, customer disputes and/or legal risks	8
7	User needs are not met (EV did not reach target SOC within departure time)	Failure to flatten curve forcing upgrades to electrical infrastructure	7
6	Customer is overcharged compared to actual cost, customer disputes and/or legal risks	Cost to resolve major disputes, requires manual intervention and/or upgrades to other infrastructure	6
5	Customer needs to pay higher than ideal costs, EV / SCM algorithm issues	Incorrect (Higher) tariffs applied by other stakeholder, unnecessary costs in resolving issues	5
4	Customer undercharged compared to actual or ideal (Ideal SCM performance) cost, may require post-charge session follow up leading to inconvenience	Incorrect (Lower) tariffs and/or Revenue loss	4
3	Inconsistent pricing and/or user confusion due to lack of transparency	Cost to resolve minor avoidable disputes	3
2	Customer has to unplug and plug into a different charger OR Underutilized power, opportunity cost for customer	Opportunity cost	2
1	No effect	No effect	1

Figure 8. Severity rating definitions, Use Case 2

2.2.4 Outcomes

The most critical faults are identified based on severity ratings only. Two severity ratings, one for the EV driver and one for the utility are assigned to each line item in the PFMEA table. A combination of these individual ratings and the average of these ratings is used to determine the most severe faults. The most severe faults and failure modes that contribute most often to severe faults are the focus of this analysis.

The most severe faults identified during the PFMEA are grid overload issues This fault could be a result of either the charger communicating a maximum current limit that is higher than the actual value due to a bug in charger software or by the vehicle interpreting the value incorrectly due to a bug in vehicle software. A bug in vehicle software will only result in grid overload in a scenario where multiple vehicles of the same make and model are connected to chargers on the same site and are simultaneously charging, which is highly unlikely. A more likely scenario where this fault could occur is where multiple chargers with a buggy software on the same site communicate a higher-than-accurate maximum current limit during concurrent active charge sessions. However, the likelihood of this scenario is also quite low since these types of software bugs are usually caught during unit testing of the charger software or during system level validation of the charger. Additionally, charger level and site level circuit protection is another factor that decreases the likelihood of this fault. Thus, this fault is ignored for this analysis.

The second most severe faults are related to communication loss between the EVSE and CSMS. Potential causes of these failures include unstable communication, network congestion, and server downtime. To address these faults, the EVSE needs to be configured to continue charging when it loses communication with the CSMS at different stages of the charge session. EVSE can also exchange important information with the CSMS early in the session to prevent this fault.

The next most severe set of faults are related to failure modes where there is a mismatch in transaction ID between the EVSE and CSMS. These faults can lead to regulatory noncompliance, the user's charging needs not being met, failure to flatten electrical demand, and

users being overcharged for their charge session. Similarly, a mismatch in EVSE ID between the EVSE and CSMS can result in the user's charging needs not being met, users being overcharged for their charge session, regulatory noncompliance, and customer disputes.

Finally, a significant portion of other faults are caused by incorrect protocol implementation and related interoperability issues. Thorough testing of communications between the EV and EVSE, EVSE and CSMS, and CSMS and pricing server plays a key role in resolving a large subset of the faults identified for this use case.

3 Conclusion

This report explores the role of communication in executing SCM at scale. It highlights the crucial role played by a resilient set of software and interface requirements as well as interoperability and compliance testing, in ensuring reliability. It also highlights the importance of validating the entire communications pipeline on a system level and the invaluable insight it provides into potential failure modes. This system-level validation can play a significant role in refining the aforementioned requirements, functional test plans, and compliance test plans.

Moreover, sequence diagrams can serve as an example or foundation for developing diagrams that capture the contents and order of information exchange more exhaustively. This allows EV charging stakeholders to repurpose these diagrams to their specific communications architecture and SCM application.

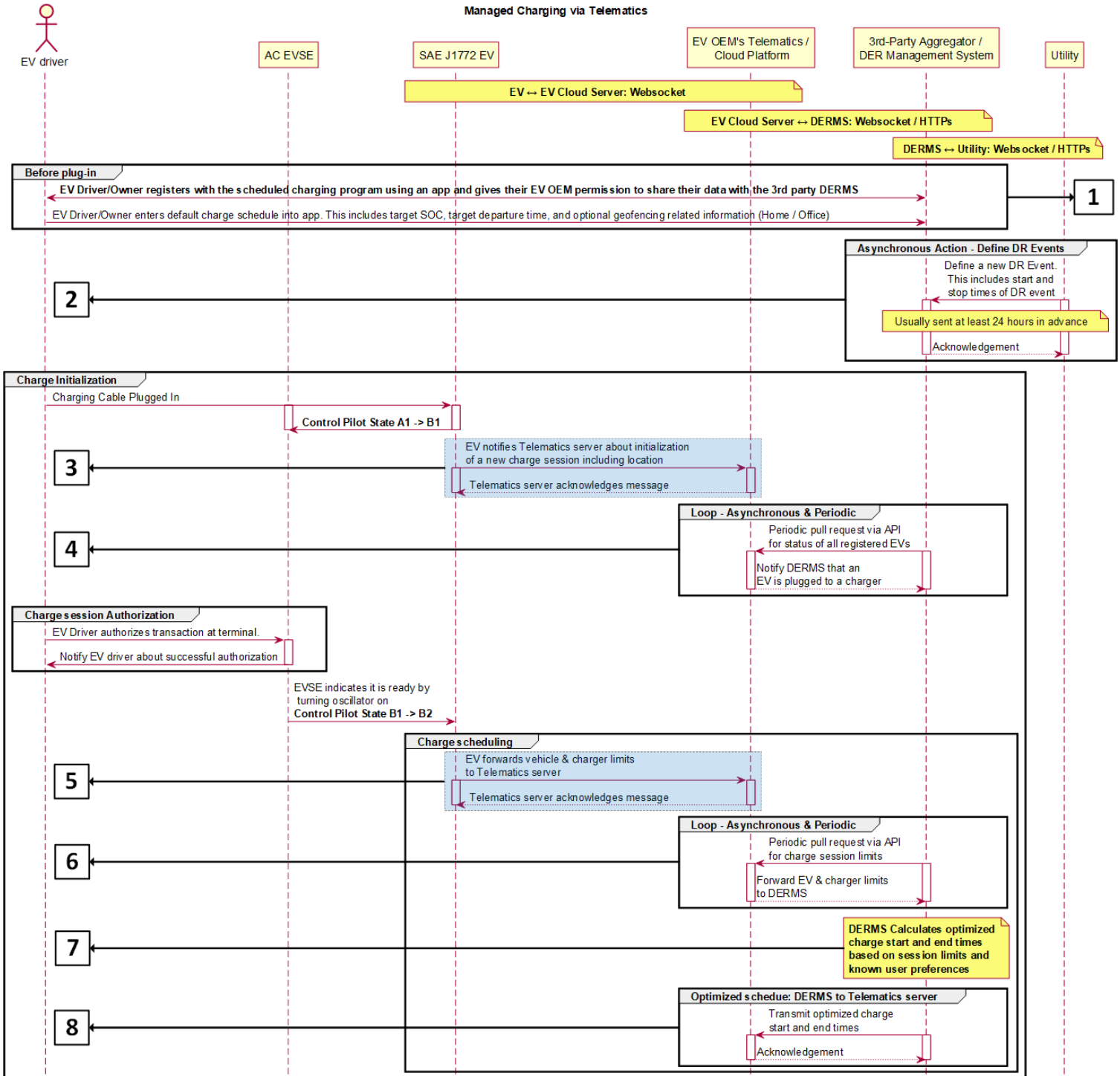
3.1 Next Steps

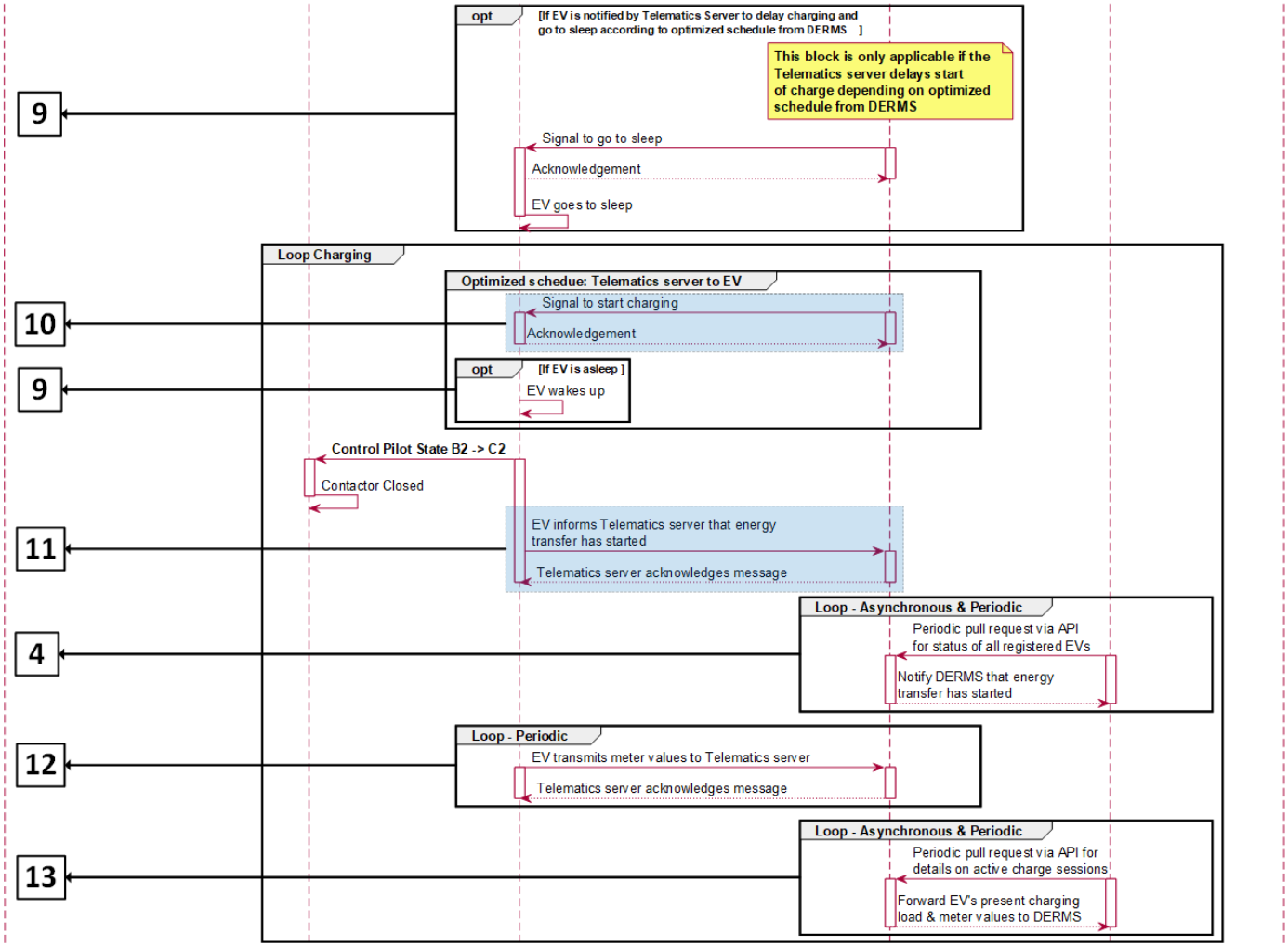
Future work could include expanding this communications reliability analysis to:

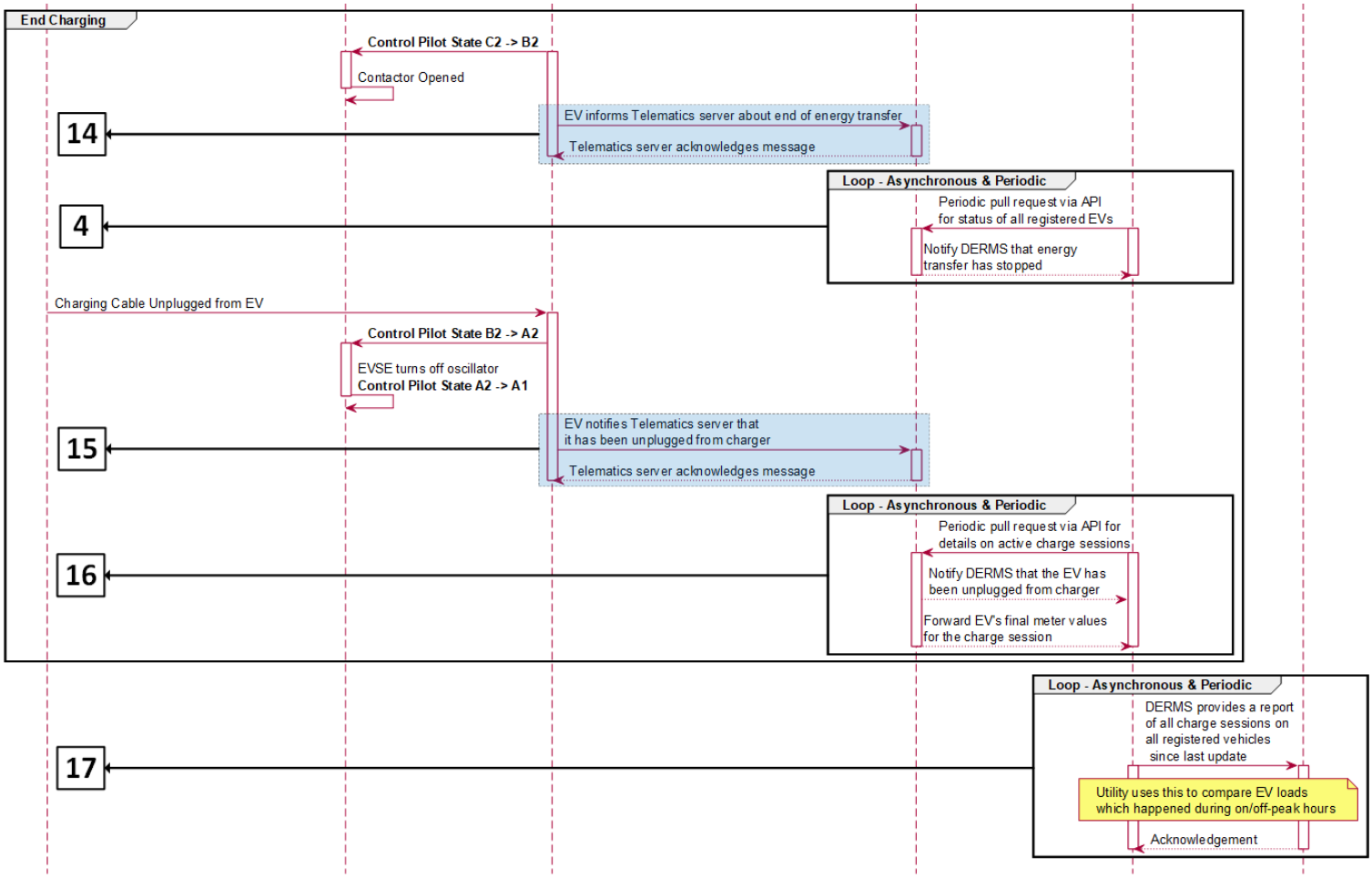
- Add "Occurrence" and "Detection" ratings as part of a full PFMEA analysis once the communication architecture and software requirements for all stakeholders are defined.
- Other SCM use cases such as transformer overload mitigation and DR.
- Various SCM use cases related to vehicle-to-grid (V2G) AC (bidirectional AC energy transfer).
- A different combination of communication protocols:
    - Like the more advanced ISO 15118-20 and OCPP 2.1 to preemptively address future issues.
    - Currently more widespread such as SAE J1772 (PWM based) and OCPP 1.6.
- Specific to V2G AC such as IEEE 2030.5 and SunSpec Modbus.
- Developing a probabilistic framework for reliability analysis as an alternative method to the traditional PFMEA based method used in this analysis. This method is further explained below

Developing a probabilistic framework for reliability analysis as an alternative method to the traditional PFMEA based method used in this analysis. This method is further explained below. This probabilistic framework should be designed to calculate the probability of failure based on the individual probabilities of successfully executing each of the steps involved in the SCM strategy. This method should be modular from a communications perspective, allowing it to be used as a comparison tool for different architecture options. It can incorporate real-world data and be combined with other vehicle-grid integration metrics to track reliability. Furthermore, such a framework provides an easily digestible benchmark to measure the efficacy of any steps taken to improve reliability, in real time. A probabilistic framework with these features could play a significant role in ensuring SCM reliability at scale.

Appendix A: Full Sequence Diagram, Use Case 1







Appendix B: PFMEA Table, Use Case 1

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
1	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate default target SOC and departure time	Driver's needs are not met	8	Database corruption
2	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate default target SOC and departure time	Driver's needs are not met	8	Manual entry error
3	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate default target SOC and departure time	Driver's needs are not met	8	Incorrect internal mapping
4	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate default target SOC and departure time	Driver's needs are not met	8	Data ingestion error
5	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate default target SOC and departure time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Database corruption
6	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate default target SOC and departure time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Manual entry error
7	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate default target SOC and departure time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Incorrect internal mapping
8	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate default target SOC and departure time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Data ingestion error
9	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Driver's needs are not met	8	Database corruption
10	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Driver's needs are not met	8	Manual entry error
11	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Driver's needs are not met	8	Incorrect internal mapping
12	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Driver's needs are not met	8	Data ingestion error
13	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Database corruption
14	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Manual entry error
15	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Incorrect internal mapping
16	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Data ingestion error
17	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Charging session cannot be shifted to off-peak hours (one EV). Unsuccessful execution of utility's DR event.	3	Database corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
18	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Charging session cannot be shifted to off-peak hours (one EV). Unsuccessful execution of utility's DR event.	3	Manual entry error
19	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Charging session cannot be shifted to off-peak hours (one EV). Unsuccessful execution of utility's DR event.	3	Incorrect internal mapping
20	1	EV owner/driver registers with the DERMS program using an app	DERMS has inaccurate target SOC and departure time for EV's location	Charging session cannot be shifted to off-peak hours (one EV). Unsuccessful execution of utility's DR event.	3	Data ingestion error
21	1	EV owner/driver registers with the DERMS program using an app	DERMS contains conflicting target SOC and departure time information	Internal DERMS error. Charging session cannot be shifted to off-peak hours (one EV). Might require manual intervention for troubleshooting	3	Owner/driver provides conflicting charging needs for same location
22	1	EV owner/driver registers with the DERMS program using an app	DERMS contains conflicting target SOC and departure time information	Internal DERMS error. Charging session cannot be shifted to off-peak hours (one EV). Might require manual intervention for troubleshooting	3	Data ingestion error
23	1	EV owner/driver registers with the DERMS program using an app	DERMS contains conflicting target SOC and departure time information	Internal DERMS error. Charging session cannot be shifted to off-peak hours (one EV). Might require manual intervention for troubleshooting	3	Error in resolving location
24	2	Define DR event and communicate its details to DERMS	DERMS and utility cannot reliably communicate with each other	Charging session cannot be shifted to off-peak hours (all EVs)	9	Unstable connection/ communication loss
25	2	Define DR event and communicate its details to DERMS	DERMS and utility cannot reliably communicate with each other	Charging session cannot be shifted to off-peak hours (all EVs)	9	Network congestion
26	2	Define DR event and communicate its details to DERMS	DERMS and utility cannot reliably communicate with each other	Charging session cannot be shifted to off-peak hours (all EVs)	9	Server downtime
27	2	Define DR event and communicate its details to DERMS	Inaccurate start and/or stop times for DR event	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Time zone mismatch
28	2	Define DR event and communicate its details to DERMS	Inaccurate start and/or stop times for DR event	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Data packet loss/ corruption
29	2	Define DR event and communicate its details to DERMS	Inaccurate start and/or stop times for DR event	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Internal failure within utility server, encoding issues
30	2	Define DR event and communicate its details to DERMS	Inaccurate start and/or stop times for DR event	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	DERMS processing issue, decoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
31	2	Define DR event and communicate its details to DERMS	Inaccurate start and/or stop times for DR event	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors
32	2	Define DR event and communicate its details to DERMS	Inaccurate start and/or stop times for DR event	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Data ingestion error
33	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Charging session cannot be shifted to off-peak hours (all EVs)	9	Time zone mismatch
34	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Charging session cannot be shifted to off-peak hours (all EVs)	9	Data packet loss/ corruption
35	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Charging session cannot be shifted to off-peak hours (all EVs)	9	Internal failure within utility server, encoding issues
36	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Charging session cannot be shifted to off-peak hours (all EVs)	9	Incorrect/ incomplete API implementation and/or API errors
37	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Charging session cannot be shifted to off-peak hours (all EVs)	9	Data ingestion error
38	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Time zone mismatch
39	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Data packet loss/ corruption
40	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	DERMS processing issue, decoding issues
41	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Incorrect/ incomplete API implementation and/or API errors
42	2	Define DR event and communicate its details to DERMS	Inaccurate default on/off-peak times	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Data ingestion error
43	2	Define DR event and communicate its details to DERMS	Inaccurate DR event information for specific location	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Time zone mismatch
44	2	Define DR event and communicate its details to DERMS	Inaccurate DR event information for specific location	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Data packet loss/ corruption
45	2	Define DR event and communicate its details to DERMS	Inaccurate DR event information for specific location	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Internal failure within utility server, encoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
46	2	Define DR event and communicate its details to DERMS	Inaccurate DR event information for specific location	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	DERMS processing issue, decoding issues
47	2	Define DR event and communicate its details to DERMS	Inaccurate DR event information for specific location	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors
48	2	Define DR event and communicate its details to DERMS	Inaccurate DR event information for specific location	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Data ingestion error
49	3	EV communicates a plug-in event to the EV OEM's telematics platform	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Unstable connection/ communication loss
50	3	EV communicates a plug-in event to the EV OEM's telematics platform	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Network congestion
51	3	EV communicates a plug-in event to the EV OEM's telematics platform	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Telematics server downtime
52	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Data packet loss/ corruption
53	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Internal failure within EV, encoding issues
54	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Telematics server processing issue, decoding issues
55	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Data ingestion error
56	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
57	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within EV, encoding issues
58	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Telematics server processing issue, decoding issues
59	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data ingestion error
60	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate location information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Data packet loss/ corruption
61	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate location information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Internal failure within EV, encoding issues
62	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate location information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Telematics server processing issue, decoding issues
63	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate location information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Data ingestion error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
64	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate location information	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
65	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate location information	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within EV, encoding issues
66	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate location information	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Telematics server processing issue, decoding issues
67	3	EV communicates a plug-in event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate location information	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data ingestion error
68	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS and telematics server cannot reliably communicate with each other	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Unstable connection/ communication loss
69	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS and telematics server cannot reliably communicate with each other	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Network congestion
70	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS and telematics server cannot reliably communicate with each other	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	High query load on telematics server
71	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS and telematics server cannot reliably communicate with each other	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Server downtime
72	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Unstable connection/ communication loss
73	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Network congestion
74	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	High query load on telematics server
75	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Server downtime
76	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent internal failure within telematics server, encoding issues
77	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent DERMS processing issue, decoding issues
78	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data ingestion error
79	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
80	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Low resolution in enumerations
81	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data packet loss/ corruption
82	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (one session only)	1	Intermittent internal failure within telematics server, encoding issues
83	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (one session only)	1	Intermittent DERMS processing issue, decoding issues
84	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (one session only)	1	Intermittent data ingestion error
85	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Charging session cannot be shifted to off-peak hours (one session only)	1	Data packet loss/ corruption
86	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Persistent internal failure within telematics server, encoding issues
87	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Persistent DERMS processing issue, decoding issues
88	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Persistent data ingestion error
89	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Incorrect/ incomplete API implementation and/or API errors
90	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Low resolution in enumerations
91	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Persistent data packet loss/ corruption
92	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (one session only)	1	Intermittent internal failure within telematics server, encoding issues
93	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (one session only)	1	Intermittent DERMS processing issue, decoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
94	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (one session only)	1	Intermittent data ingestion error
95	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete status information	Owner/driver is charged higher-than-optimal cost for the charge session (one session only)	1	Data packet loss/ corruption
96	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent internal failure within telematics server, encoding issues
97	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent DERMS processing issue, decoding issues
98	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data ingestion error
99	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors
100	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Low resolution in enumerations
101	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data packet loss/ corruption
102	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (one session only)	1	Intermittent internal failure within telematics server, encoding issues
103	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (one session only)	1	Intermittent DERMS processing issue, decoding issues
104	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (one session only)	1	Intermittent data ingestion error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
105	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Charging session cannot be shifted to off-peak hours (one session only)	1	Data packet loss/ corruption
106	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Persistent internal failure within telematics server, encoding issues
107	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Persistent DERMS processing issue, decoding issues
108	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Persistent data ingestion error
109	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Incorrect/ incomplete API implementation and/or API errors
110	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Low resolution in enumerations
111	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Persistent data packet loss/ corruption
112	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (one session only)	1	Intermittent internal failure within telematics server, encoding issues
113	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (one session only)	1	Intermittent DERMS processing issue, decoding issues
114	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (one session only)	1	Intermittent data ingestion error
115	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives inaccurate or incomplete location information (not applicable to updates other than plug-in and unplug events)	Owner/driver is charged higher-than-optimal cost for the charge session (one session only)	1	Data packet loss/ corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
116	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives status and location update for wrong EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent internal failure within telematics server, encoding issues
117	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives status and location update for wrong EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent DERMS processing issue, decoding issues
118	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives status and location update for wrong EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data ingestion error
119	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives status and location update for wrong EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors
120	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives status and location update for wrong EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Low resolution in enumerations
121	4	DERMS asynchronously polls telematics server for status updates on all registered EVs	DERMS receives status and location update for wrong EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data packet loss/ corruption
122	5	EV forwards vehicle and charger limits for the session to the telematics server	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Unstable connection/ communication loss
123	5	EV forwards vehicle and charger limits for the session to the telematics server	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Network congestion
124	5	EV forwards vehicle and charger limits for the session to the telematics server	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Telematics server downtime
125	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner's/driver's needs are not met, higher-than-actual vehicle limits are received	8	Internal failure within EV, encoding issues
126	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner's/driver's needs are not met, higher-than-actual vehicle limits are received	8	Telematics server processing issue, decoding issues
127	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner's/driver's needs are not met, higher-than-actual vehicle limits are received	8	Data packet loss/ corruption
128	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner's/driver's needs are not met, higher-than-actual vehicle limits are received	8	Data ingestion error
129	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner/driver is charged higher-than-optimal cost for the charge session (one session only), lower-than-actual vehicle limits are received	1	Internal failure within EV, encoding issues
130	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner/driver is charged higher-than-optimal cost for the charge session (one session only), lower-than-actual vehicle limits are received	1	Telematics server processing issue, decoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
131	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner/driver is charged higher-than-optimal cost for the charge session (one session only), lower-than-actual vehicle limits are received	1	Data packet loss/ corruption
132	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server receives inaccurate session limits	Owner/driver is charged higher-than-optimal cost for the charge session (one session only), lower-than-actual vehicle limits are received	1	Data ingestion error
133	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session/EV internally	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Internal failure within EV, encoding issues
134	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session/EV internally	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Telematics server processing issue, decoding issues
135	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session/EV internally	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Data packet loss/ corruption
136	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session/EV internally	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Data ingestion error
137	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session/EV internally	Owner/driver is charged higher-than-optimal cost for the charge session (one session only), lower-than-actual limits are received	1	Intermittent internal failure within EV, encoding issues
138	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session/EV internally	Owner/driver is charged higher-than-optimal cost for the charge session (one session only), lower-than-actual limits are received	1	Intermittent telematics server processing issue, decoding issues
139	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session/EV internally	Owner/driver is charged higher-than-optimal cost for the charge session (one session only), lower-than-actual limits are received	1	Intermittent data packet loss/ corruption
140	5	EV forwards vehicle and charger limits for the session to the telematics server	Telematics server assigns session limits to wrong active session/EV internally	Owner/driver is charged higher-than-optimal cost for the charge session (one session only), lower-than-actual limits are received	1	Intermittent data ingestion error
141	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Unstable connection/ communication loss
142	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Network congestion
143	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	High query load on telematics server

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
144	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Server downtime
145	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Intermittent internal failure within telematics server, encoding issues
146	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Intermittent DERMS processing issue, decoding issues
147	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Intermittent data ingestion error
148	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Data packet loss/ corruption
149	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent internal failure within telematics server, encoding issues
150	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent DERMS processing issue, decoding issues
151	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data ingestion error
152	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors
153	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data packet loss/ corruption
154	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent internal failure within telematics server, encoding issues
155	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent DERMS processing issue, decoding issues
156	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent data ingestion error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
157	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives inaccurate session limits	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Data packet loss/ corruption
158	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Owner's/driver's needs are not met	8	Intermittent internal failure within telematics server, encoding issues
159	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Owner's/driver's needs are not met	8	Intermittent DERMS processing issue, decoding issues
160	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Owner's/driver's needs are not met	8	Intermittent data ingestion error
161	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Owner's/driver's needs are not met	8	Data packet loss/ corruption
162	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent internal failure within telematics server, encoding issues
163	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent DERMS processing issue, decoding issues
164	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data ingestion error
165	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors
166	6	DERMS polls telematics server for vehicle and charger limits for active sessions	DERMS receives session limits for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data packet loss/ corruption
167	7	DERMS calculates optimal start and end times for the charge session	Nonoptimal start and end times calculated by DERMS	Owner's/driver's needs are not met	8	High latency in transferring session limits from EV to DERMS
168	7	DERMS calculates optimal start and end times for the charge session	Nonoptimal start and end times calculated by DERMS	Owner's/driver's needs are not met	8	Internal DERMS error
169	7	DERMS calculates optimal start and end times for the charge session	Nonoptimal start and end times calculated by DERMS	Owner's/driver's needs are not met	8	SCM algorithm error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
170	7	DERMS calculates optimal start and end times for the charge session	Nonoptimal start and end times calculated by DERMS	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Internal database corruption
171	7	DERMS calculates optimal start and end times for the charge session	Nonoptimal start and end times calculated by DERMS	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	Internal DERMS error
172	7	DERMS calculates optimal start and end times for the charge session	Nonoptimal start and end times calculated by DERMS	Owner/driver is charged higher-than-optimal cost for the charge session (multiple EVs)	6	SCM algorithm error
173	8	DERMS communicates optimal start and end times to telematics server	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Unstable connection/ communication loss
174	8	DERMS communicates optimal start and end times to telematics server	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Network congestion
175	8	DERMS communicates optimal start and end times to telematics server	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	High query load on telematics server
176	8	DERMS communicates optimal start and end times to telematics server	DERMS and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Server downtime
177	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Intermittent internal failure within telematics server, decoding issues
178	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Intermittent DERMS processing issue, encoding issues
179	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Intermittent data ingestion error
180	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Owner's/driver's needs are not met, higher-than-actual limits are received	8	Data packet loss/ corruption
181	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Charging session cannot be shifted to off-peak hours (all EVs)	9	Persistent DERMS processing issue, encoding issues
182	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent internal failure within telematics server, decoding issues
183	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent DERMS processing issue, encoding issues
184	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data ingestion error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
185	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors
186	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data packet loss/ corruption
187	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent internal failure within telematics server, decoding issues
188	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent DERMS processing issue, encoding issues
189	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent data ingestion error
190	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives inaccurate start and end times	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Data packet loss/ corruption
191	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Owner's/driver's needs are not met	8	Intermittent internal failure within telematics server, decoding issues
192	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Owner's/driver's needs are not met	8	Intermittent DERMS processing issue, encoding issues
193	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Owner's/driver's needs are not met	8	Intermittent data ingestion error
194	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Owner's/driver's needs are not met	8	Data packet loss/ corruption
195	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Charging session cannot be shifted to off-peak hours (all EVs)	9	Persistent DERMS processing issue, encoding issues
196	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent internal failure within telematics server, decoding issues
197	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent DERMS processing issue, encoding issues
198	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data ingestion error
199	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Incorrect/ incomplete API implementation and/or API errors

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
200	8	DERMS communicates optimal start and end times to telematics server	Telematics server receives start and end times for wrong active session/EV	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data packet loss/ corruption
201	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV and telematics server cannot reliably communicate with each other	EV is inoperable (if EV does not time out and go to sleep)	10	Unstable connection/ communication loss
202	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV and telematics server cannot reliably communicate with each other	EV is inoperable (if EV does not time out and go to sleep)	10	Network congestion
203	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV and telematics server cannot reliably communicate with each other	EV is inoperable (if EV does not time out and go to sleep)	10	Telematics server downtime
204	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	Unstable connection/ communication loss
205	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	Network congestion
206	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	Telematics server downtime
207	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not receive "go to sleep" signal	EV is inoperable (if EV does not time out and go to sleep)	10	Intermittent internal failure within EV, decoding issues
208	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not receive "go to sleep" signal	EV is inoperable (if EV does not time out and go to sleep)	10	Intermittent telematics server processing issue, encoding issues
209	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not receive "go to sleep" signal	EV is inoperable (if EV does not time out and go to sleep)	10	Intermittent data packet loss/ corruption
210	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not receive "go to sleep" signal	EV is inoperable (if EV does not time out and go to sleep)	10	Intermittent data ingestion error
211	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not receive "go to sleep" signal	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	Intermittent internal failure within EV, decoding issues
212	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not receive "go to sleep" signal	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	Intermittent telematics server processing issue, encoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
213	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not receive "go to sleep" signal	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	Intermittent data packet loss/ corruption
214	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not receive "go to sleep" signal	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	Intermittent data ingestion error
215	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not support going to sleep/does not go to sleep	EV is inoperable (if EV does not time out and go to sleep)	10	EV is on an older firmware that does not support this functionality
216	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not support going to sleep/does not go to sleep	EV is inoperable (if EV does not time out and go to sleep)	10	Internal EV error in going to sleep
217	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not support going to sleep/does not go to sleep	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	EV is on an older firmware that does not support this functionality
218	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not support going to sleep/does not go to sleep	Owner/driver is charged with the same cost as no managed charging (if EV times out and defaults to unmanaged charging)	5	Internal EV error in going to sleep
219	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV goes to sleep at the wrong time	Owner's/driver's needs are not met	8	Internal EV error
220	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV goes to sleep at the wrong time	Owner's/driver's needs are not met	8	Communication latency
221	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV goes to sleep at the wrong time	Owner's/driver's needs are not met	8	Network congestion
222	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV goes to sleep at the wrong time	Owner's/driver's needs are not met	8	Telematics server downtime
223	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not wake up at the right time	Owner's/driver's needs are not met	8	Internal failure within EV, decoding issues
224	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not wake up at the right time	Owner's/driver's needs are not met	8	Telematics server processing issue, encoding issues
225	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not wake up at the right time	Owner's/driver's needs are not met	8	Data packet loss/ corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
226	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not wake up at the right time	Owner's/driver's needs are not met	8	Data ingestion error
227	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not wake up at the right time	Owner's/driver's needs are not met	8	Communication latency
228	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not wake up at the right time	Owner's/driver's needs are not met	8	Network congestion
229	9	Telematics server communicates to the EV to delay charge session for optimized cost	EV does not wake up at the right time	Owner's/driver's needs are not met	8	Telematics server downtime
230	9	Telematics server communicates to the EV to delay charge session for optimized cost	EVSE assumes EV is disconnected instead of sleeping	Owner's/driver's needs are not met (if EVSE does not wake up/reset itself)	8	EVSE does not support EV's state when it is plugged in but asleep
231	9	Telematics server communicates to the EV to delay charge session for optimized cost	EVSE assumes EV is disconnected instead of sleeping	Owner's/driver's needs are not met (if EVSE does not wake up/reset itself)	8	EVSE does not support pilot wake
232	10	Telematics server communicates to the EV to start charging	EV and telematics server cannot reliably communicate with each other	Owner's/driver's needs are not met	8	Unstable connection/ communication loss
233	10	Telematics server communicates to the EV to start charging	EV and telematics server cannot reliably communicate with each other	Owner's/driver's needs are not met	8	Network congestion
234	10	Telematics server communicates to the EV to start charging	EV and telematics server cannot reliably communicate with each other	Owner's/driver's needs are not met	8	Telematics server downtime
235	10	Telematics server communicates to the EV to start charging	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Unstable connection/ communication loss
236	10	Telematics server communicates to the EV to start charging	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Network congestion
237	10	Telematics server communicates to the EV to start charging	EV and telematics server cannot reliably communicate with each other	Owner/driver is charged with the same cost as no managed charging	5	Telematics server downtime
238	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent telematics server processing issue, encoding issues
239	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Internal telematics server database corruption
240	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent data packet loss/ corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
241	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Charging session cannot be shifted to off-peak hours (multiple EVs)	7	Persistent communication latency
242	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged with the same cost as no managed charging (if error is detectable by EV)	5	Intermittent internal failure within EV, decoding issues
243	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged with the same cost as no managed charging (if error is detectable by EV)	5	Intermittent telematics server processing issue, encoding issues
244	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged with the same cost as no managed charging (if error is detectable by EV)	5	Intermittent data packet loss/ corruption
245	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged with the same cost as no managed charging (if error is detectable by EV)	5	Intermittent data ingestion error
246	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged with the same cost as no managed charging (if error is detectable by EV)	5	Intermittent communication latency
247	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent internal failure within EV, decoding issues
248	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent telematics server processing issue, encoding issues
249	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent data packet loss/ corruption
250	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent data ingestion error
251	10	Telematics server communicates to the EV to start charging	EV does not receive "start charging" signal at the right time	Owner/driver is charged higher-than-optimal cost for the charge session (one EV)	4	Intermittent communication latency
252	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Unstable connection/ communication loss
253	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Network congestion
254	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Telematics server downtime
255	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within EV, encoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
256	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Telematics server processing issue, decoding issues
257	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
258	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data ingestion error
259	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent telematics server processing issue, decoding issues
260	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
261	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
262	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent internal failure within EV, encoding issues
263	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent telematics server processing issue, decoding issues
264	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent data packet loss/ corruption
265	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent data ingestion error
266	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge shift details to utility	7	Internal failure within EV, encoding issues
267	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge shift details to utility	7	Telematics server processing issue, decoding issues
268	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge shift details to utility	7	Data packet loss/ corruption
269	11	EV communicates to the EV OEM's telematics platform that energy transfer has started	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge shift details to utility	7	Data ingestion error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
270	12	EV transmits meter values during the active charge session to telematics server	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Unstable connection/ communication loss
271	12	EV transmits meter values during the active charge session to telematics server	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Network congestion
272	12	EV transmits meter values during the active charge session to telematics server	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Telematics server downtime
273	12	EV transmits meter values during the active charge session to telematics server	Telematics server receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent telematics server processing issue, decoding issues
274	12	EV transmits meter values during the active charge session to telematics server	Telematics server receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
275	12	EV transmits meter values during the active charge session to telematics server	Telematics server receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
276	12	EV transmits meter values during the active charge session to telematics server	Telematics server receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	EV measurement error
277	12	EV transmits meter values during the active charge session to telematics server	Telematics server receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent internal failure within EV, encoding issues
278	12	EV transmits meter values during the active charge session to telematics server	Telematics server receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent telematics server processing issue, decoding issues
279	12	EV transmits meter values during the active charge session to telematics server	Telematics server receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent data packet loss/ corruption
280	12	EV transmits meter values during the active charge session to telematics server	Telematics server receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent data ingestion error
281	12	EV transmits meter values during the active charge session to telematics server	Telematics server assigns session info to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within EV, encoding issues
282	12	EV transmits meter values during the active charge session to telematics server	Telematics server assigns session info to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Telematics server processing issue, decoding issues
283	12	EV transmits meter values during the active charge session to telematics server	Telematics server assigns session info to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
284	12	EV transmits meter values during the active charge session to telematics server	Telematics server assigns session info to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data ingestion error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
285	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Unstable connection/ communication loss
286	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Network congestion
287	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	High query load on telematics server
288	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Server downtime
289	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent internal failure within telematics server, encoding issues
290	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent DERMS processing issue, decoding issues
291	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent data ingestion error
292	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
293	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	EV measurement error
294	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within telematics server, encoding issues
295	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, decoding issues
296	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
297	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Incorrect/ incomplete API implementation and/or API errors

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
298	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
299	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent internal failure within telematics server, encoding issues
300	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent DERMS processing issue, decoding issues
301	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent data ingestion error
302	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Data packet loss/ corruption
303	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent internal failure within telematics server, encoding issues
304	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent DERMS processing issue, decoding issues
305	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent data ingestion error
306	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
307	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within telematics server, encoding issues
308	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, decoding issues
309	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
310	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Incorrect/ incomplete API implementation and/or API errors

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
311	13	DERMS polls telematics server for charging load and meter values for active sessions	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
312	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Unstable connection/ communication loss
313	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Network congestion
314	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Telematics server downtime
315	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within EV, encoding issues
316	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Telematics server processing issue, decoding issues
317	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
318	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data ingestion error
319	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent telematics server processing issue, decoding issues
320	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
321	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
322	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent internal failure within EV, encoding issues
323	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent telematics server processing issue, decoding issues
324	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent data packet loss/ corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
325	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server does not receive accurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent data ingestion error
326	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within EV, encoding issues
327	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Telematics server processing issue, decoding issues
328	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
329	14	EV communicates to the EV OEM's telematics platform that energy transfer has stopped	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data ingestion error
330	15	EV communicates an unplug event to the EV OEM's telematics platform	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Unstable connection/ communication loss
331	15	EV communicates an unplug event to the EV OEM's telematics platform	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Network congestion
332	15	EV communicates an unplug event to the EV OEM's telematics platform	EV and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Telematics server downtime
333	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within EV, encoding issues
334	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Telematics server processing issue, decoding issues
335	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
336	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data ingestion error
337	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent telematics server processing issue, decoding issues
338	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
339	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
340	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent internal failure within EV, encoding issues
341	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent telematics server processing issue, decoding issues
342	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent data packet loss/ corruption
343	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server receives corrupted/inaccurate status update	DERMS cannot accurately track and report successful shift in charging times (one session)	2	Intermittent data ingestion error
344	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within EV, encoding issues
345	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Telematics server processing issue, decoding issues
346	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
347	15	EV communicates an unplug event to the EV OEM's telematics platform	Telematics server assigns status update to wrong active session/EV internally	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data ingestion error
348	16	DERMS polls telematics server for change in charging status and final meter values	DERMS and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Unstable connection/ communication loss
349	16	DERMS polls telematics server for change in charging status and final meter values	DERMS and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Network congestion
350	16	DERMS polls telematics server for change in charging status and final meter values	DERMS and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	High query load on telematics server
351	16	DERMS polls telematics server for change in charging status and final meter values	DERMS and telematics server cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Server downtime
352	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent internal failure within telematics server, encoding issues
353	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent DERMS processing issue, decoding issues
354	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent data ingestion error

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
355	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
356	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within telematics server, encoding issues
357	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, decoding issues
358	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
359	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Incorrect/ incomplete API implementation and/or API errors
360	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
361	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Low resolution in enumerations
362	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent internal failure within telematics server, encoding issues
363	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent DERMS processing issue, decoding issues
364	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent data ingestion error
365	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate or incomplete status information	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Data packet loss/ corruption
366	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent internal failure within telematics server, encoding issues
367	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent DERMS processing issue, decoding issues

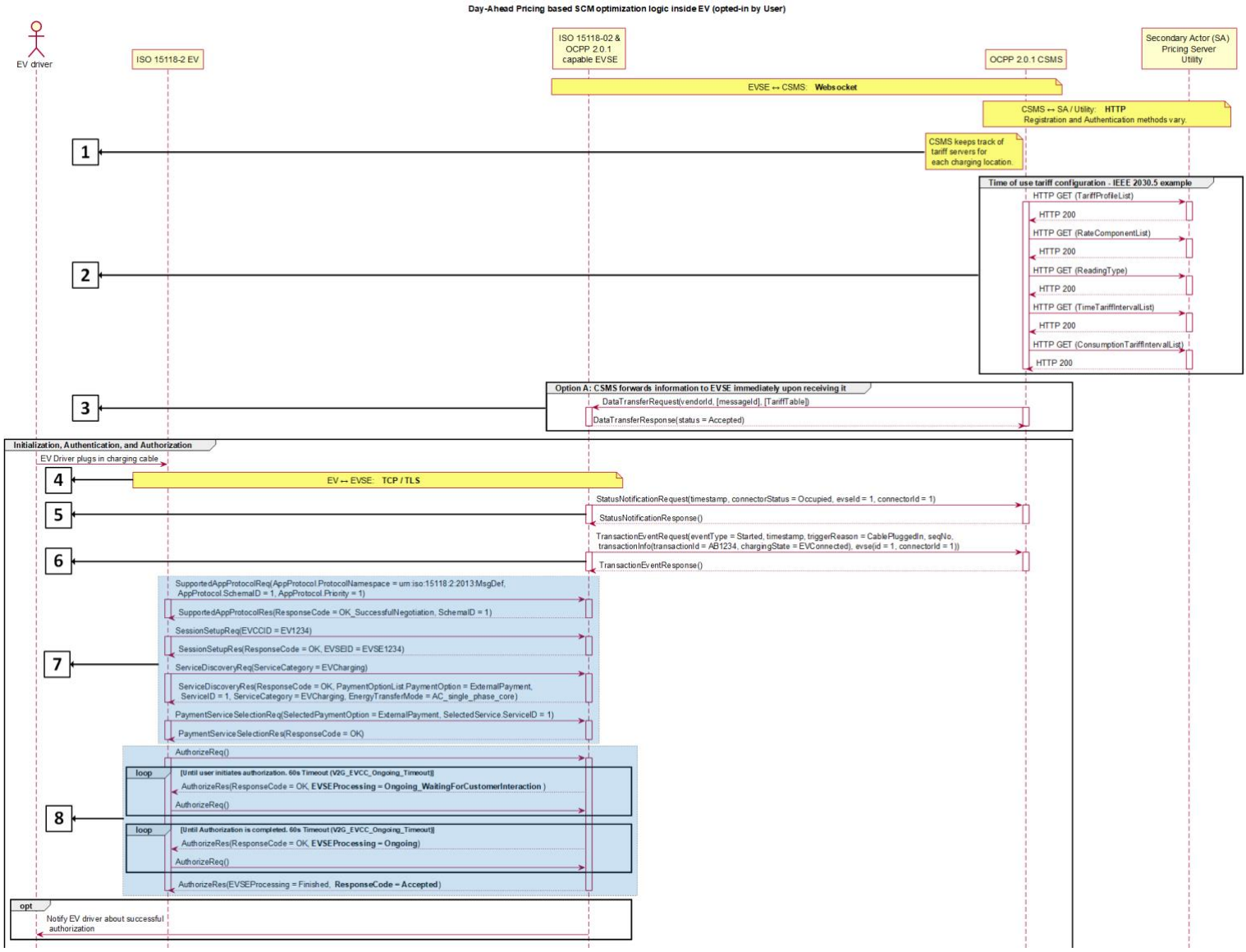
ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
368	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent data ingestion error
369	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
370	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	EV measurement error
371	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within telematics server, encoding issues
372	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, decoding issues
373	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
374	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Incorrect/ incomplete API implementation and/or API errors
375	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives status and location update for wrong EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
376	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent internal failure within telematics server, encoding issues
377	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent DERMS processing issue, decoding issues
378	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent data ingestion error
379	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
380	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within telematics server, encoding issues
381	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, decoding issues

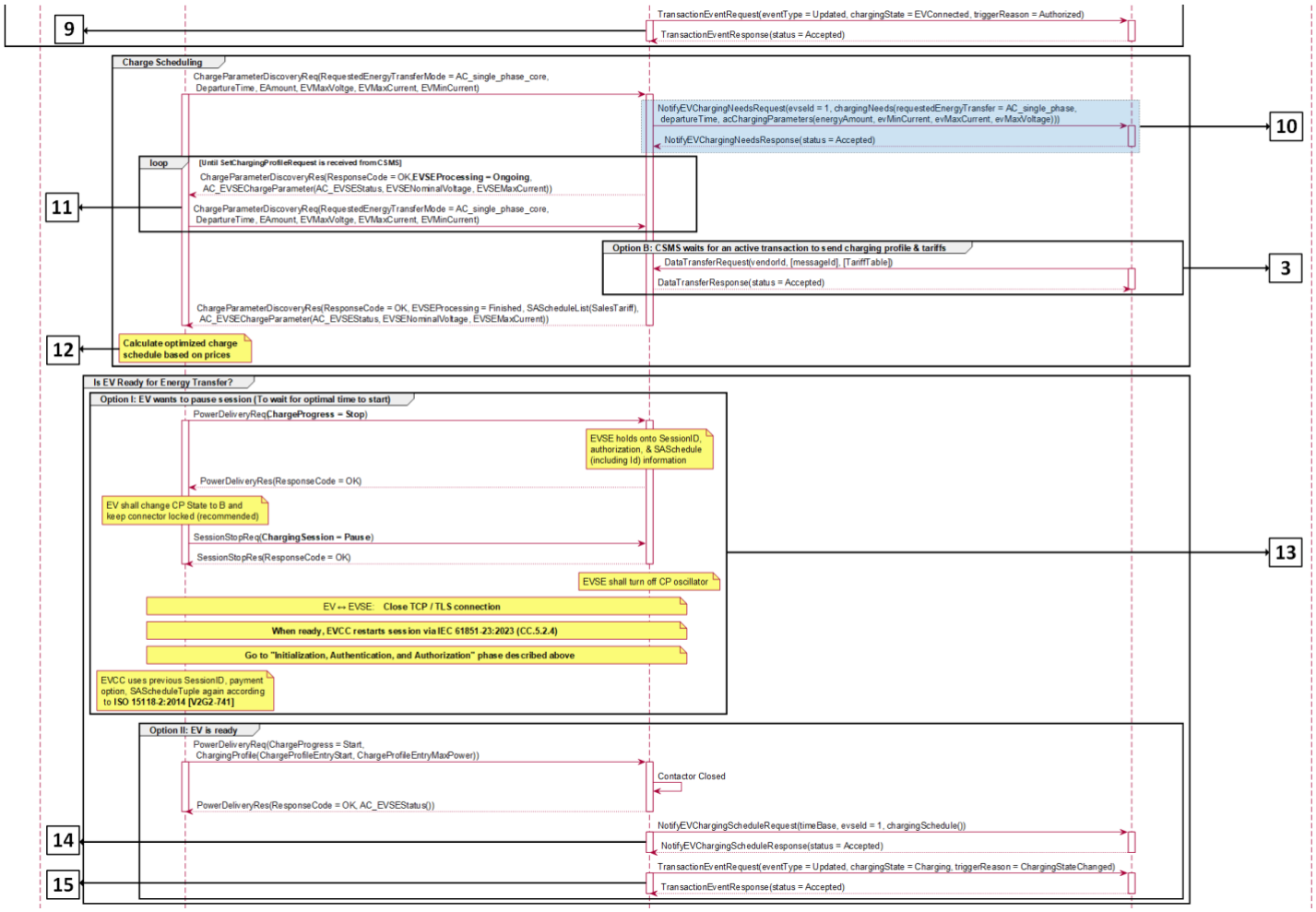
ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
382	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
383	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Incorrect/ incomplete API implementation and/or API errors
384	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
385	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent internal failure within telematics server, encoding issues
386	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent DERMS processing issue, decoding issues
387	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Intermittent data ingestion error
388	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives inaccurate charging load and/or meter values	DERMS cannot accurately track and report successful shift in charging times (one EV/session)	2	Data packet loss/ corruption
389	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent internal failure within telematics server, encoding issues
390	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent DERMS processing issue, decoding issues
391	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Intermittent data ingestion error
392	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
393	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within telematics server, encoding issues
394	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, decoding issues

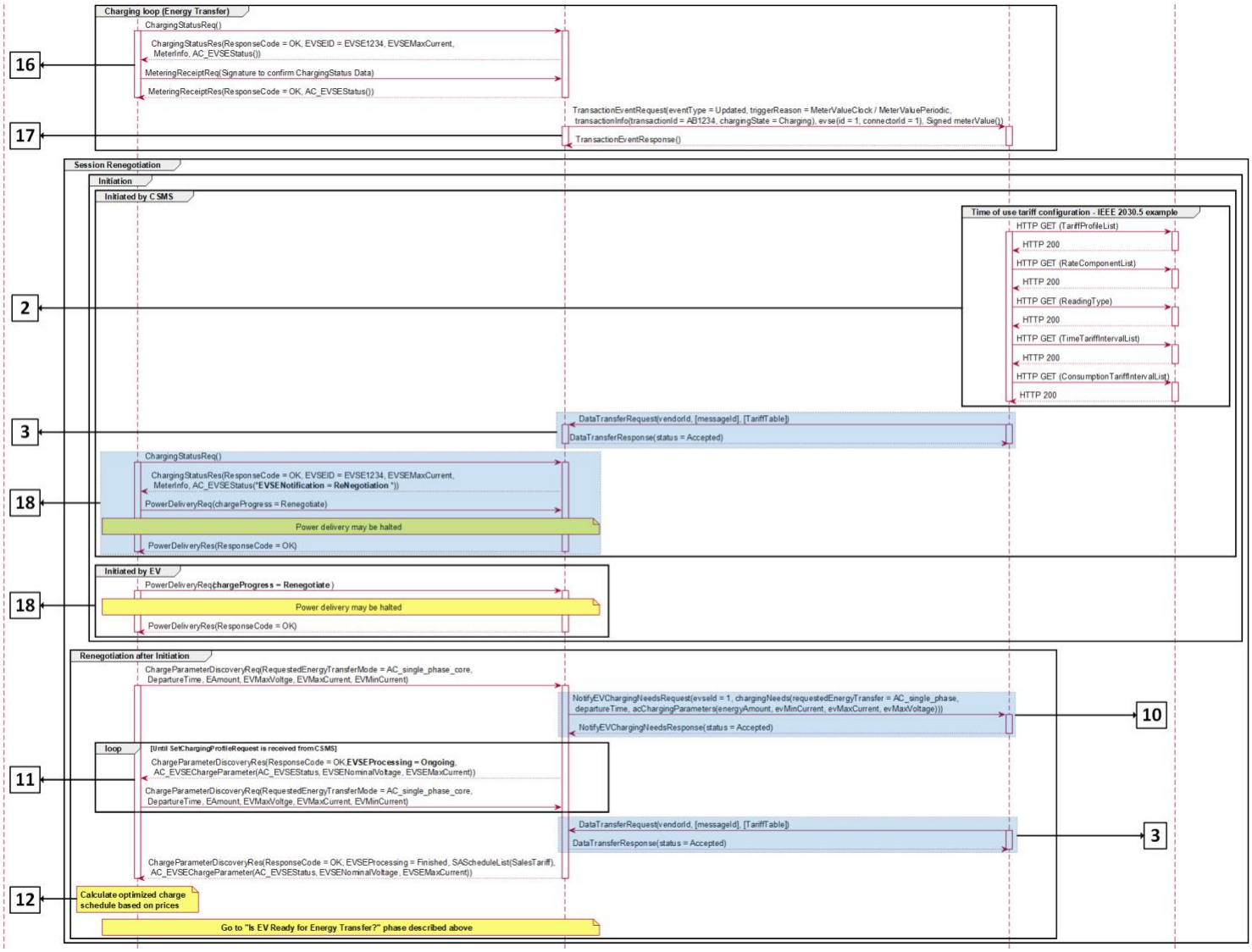
ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
395	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data ingestion error
396	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Incorrect/ incomplete API implementation and/or API errors
397	16	DERMS polls telematics server for change in charging status and final meter values	DERMS receives charging load/ meter values for wrong active session/EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
398	17	DERMS periodically provides a report of all charge sessions on registered vehicles	DERMS and utility cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Unstable connection/ communication loss
399	17	DERMS periodically provides a report of all charge sessions on registered vehicles	DERMS and utility cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Network congestion
400	17	DERMS periodically provides a report of all charge sessions on registered vehicles	DERMS and utility cannot reliably communicate with each other	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Server downtime
401	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate start and/or stop times for a registered EV's sessions	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within utility server, decoding issues
402	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate start and/or stop times for a registered EV's sessions	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	DERMS processing issue, encoding issues
403	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate start and/or stop times for a registered EV's sessions	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Incorrect/ incomplete API implementation and/or API errors
404	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate start and/or stop times for a registered EV's sessions	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
405	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate start and/or stop times for a registered EV's sessions	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within utility server, decoding issues
406	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate start and/or stop times for a registered EV's sessions	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, encoding issues
407	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate start and/or stop times for a registered EV's sessions	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
408	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate meter value for a registered EV's sessions	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within utility server, decoding issues

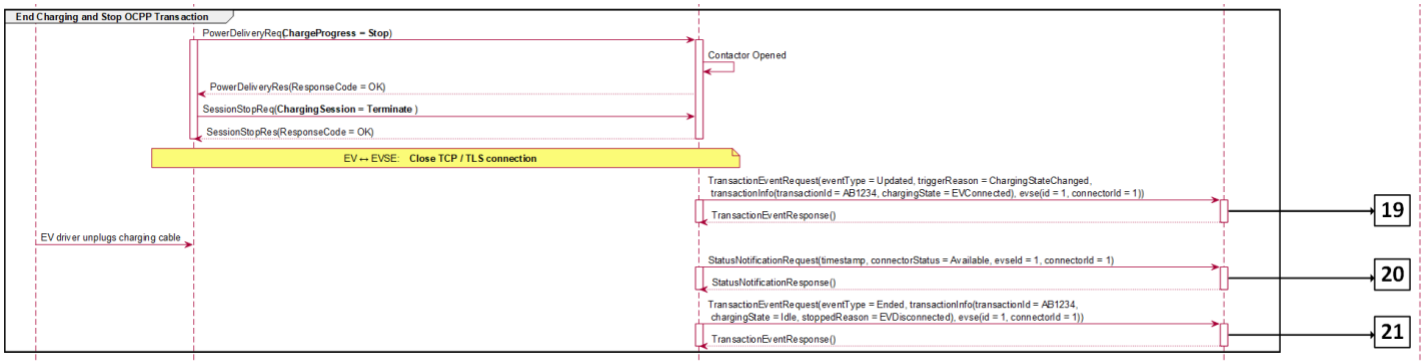
ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Severity of Failure	Potential Cause of Failure
409	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate meter value for a registered EV's sessions	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	DERMS processing issue, encoding issues
410	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate meter value for a registered EV's sessions	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Incorrect/ incomplete API implementation and/or API errors
411	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate meter value for a registered EV's sessions	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
412	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate meter value for a registered EV's sessions	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within utility server, decoding issues
413	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate meter value for a registered EV's sessions	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, encoding issues
414	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives inaccurate meter value for a registered EV's sessions	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption
415	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives session details for the wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Internal failure within utility server, decoding issues
416	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives session details for the wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	DERMS processing issue, encoding issues
417	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives session details for the wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Incorrect/ incomplete API implementation and/or API errors
418	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives session details for the wrong EV	DERMS reports inaccurate charge summary to utility (if error is not detectable)	7	Data packet loss/ corruption
419	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives session details for the wrong EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent internal failure within utility server, decoding issues
420	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives session details for the wrong EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent DERMS processing issue, encoding issues
421	17	DERMS periodically provides a report of all charge sessions on registered vehicles	Utility receives session details for the wrong EV	DERMS cannot accurately track and report successful shift in charging times (multiple EVs)	5	Persistent data packet loss/ corruption

Appendix C: Full Sequence Diagram, Use Case 2









Appendix D: PFMEA Table, Use Case 2

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
1	1	CSMS keeps track of tariff servers for each charging location	CSMS loses track of tariff server for a charging location	Wrong/default tariffs applied, customer disputes (higher-than-actual session cost)	6	5	5.5	Database corruption
2	1	CSMS keeps track of tariff servers for each charging location	CSMS loses track of tariff server for a charging location	Wrong/default tariffs applied, customer disputes (higher-than-actual session cost)	6	5	5.5	Manual entry error
3	1	CSMS keeps track of tariff servers for each charging location	CSMS loses track of tariff server for a charging location	Wrong/default tariffs applied, customer disputes (higher-than-actual session cost)	6	5	5.5	Incorrect mapping
4	1	CSMS keeps track of tariff servers for each charging location	CSMS loses track of tariff server for a charging location	Wrong/default tariffs applied, revenue loss (lower-than-actual session cost)	4	5	4.5	Database corruption
5	1	CSMS keeps track of tariff servers for each charging location	CSMS loses track of tariff server for a charging location	Wrong/default tariffs applied, revenue loss (lower-than-actual session cost)	4	5	4.5	Manual entry error
6	1	CSMS keeps track of tariff servers for each charging location	CSMS loses track of tariff server for a charging location	Wrong/default tariffs applied, revenue loss (lower-than-actual session cost)	4	5	4.5	Incorrect mapping
7	1	CSMS keeps track of tariff servers for each charging location	CSMS accesses the wrong tariff server for a charging location	Wrong tariffs applied, customer disputes (higher-than-ideal session cost)	6	5	5.5	Database corruption
8	1	CSMS keeps track of tariff servers for each charging location	CSMS accesses the wrong tariff server for a charging location	Wrong tariffs applied, customer disputes (higher-than-ideal session cost)	6	5	5.5	Manual entry error
9	1	CSMS keeps track of tariff servers for each charging location	CSMS accesses the wrong tariff server for a charging location	Wrong tariffs applied, customer disputes (higher-than-ideal session cost)	6	5	5.5	Incorrect mapping
10	1	CSMS keeps track of tariff servers for each charging location	CSMS accesses the wrong tariff server for a charging location	Wrong/default tariffs applied, revenue loss (lower-than-ideal session cost)	4	5	4.5	Database corruption
11	1	CSMS keeps track of tariff servers for each charging location	CSMS accesses the wrong tariff server for a charging location	Wrong/default tariffs applied, revenue loss (lower-than-ideal session cost)	4	5	4.5	Manual entry error
12	1	CSMS keeps track of tariff servers for each charging location	CSMS accesses the wrong tariff server for a charging location	Wrong/default tariffs applied, revenue loss (lower-than-ideal session cost)	4	5	4.5	Incorrect mapping
13	1	CSMS keeps track of tariff servers for each charging location	CSMS contains duplicate or conflicting tariff servers for a charging location	Inconsistent pricing and user confusion	6	5	5.5	Multiple sources of truth

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
14	1	CSMS keeps track of tariff servers for each charging location	CSMS contains duplicate or conflicting tariff servers for a charging location	Internal CSMS error while fetching tariffs	8	5	6.5	Multiple sources of truth
15	2	CSMS gets tariffs from ADMS/ DERMS/utility	CSMS and tariff server cannot reliably communicate with each other	Failed charging session **ONLY** if default tariffs are not configured	6	8	7	Unstable connection/ communication loss
16	2	CSMS gets tariffs from ADMS/ DERMS/utility	CSMS and tariff server cannot reliably communicate with each other	Failed charging session ONLY if default tariffs are not configured	6	8	7	Network congestion
17	2	CSMS gets tariffs from ADMS/ DERMS/utility	CSMS and tariff server cannot reliably communicate with each other	Failed charging session ONLY if default tariffs are not configured	6	8	7	Server downtime
18	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, customer disputes (higher-than-ideal session cost)	5	8	6.5	Time zone mismatch
19	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, customer disputes (higher-than-ideal session cost)	5	8	6.5	Data packet loss/corruption
20	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, customer disputes (higher-than-ideal session cost)	5	8	6.5	Internal failure within tariff server, encoding issues
21	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, customer disputes (higher-than-ideal session cost)	5	8	6.5	CSMS processing issue, decoding issues
22	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, customer disputes (higher-than-ideal session cost)	5	8	6.5	Incorrect/ incomplete protocol implementation
23	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong/default tariffs applied, revenue loss (lower-than-ideal session cost)	4	8	6	Time zone mismatch
24	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong/default tariffs applied, revenue loss (lower-than-ideal session cost)	4	8	6	Data packet loss/corruption
25	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong/default tariffs applied, revenue loss (lower-than-ideal session cost)	4	8	6	Internal failure within tariff server, encoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
26	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong/default tariffs applied, revenue loss (lower-than-ideal session cost)	4	8	6	CSMS processing issue, decoding issues
27	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong/default tariffs applied, revenue loss (lower-than-ideal session cost)	4	8	6	Incorrect/ incomplete protocol implementation
28	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	4	7	5.5	Time zone mismatch
29	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	4	7	5.5	Data packet loss/corruption
30	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	4	7	5.5	Internal failure within tariff server, encoding issues
31	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	4	7	5.5	CSMS processing issue, decoding issues
32	2	CSMS gets tariffs from ADMS/ DERMS/utility	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	4	7	5.5	Incorrect/ incomplete protocol implementation
33	2	CSMS gets tariffs from ADMS/ DERMS/utility	Outdated tariffs	Undercharging customer, revenue loss	4	8	6	Internal failure within tariff server
34	2	CSMS gets tariffs from ADMS/ DERMS/utility	Outdated tariffs	Overcharging customer, legal compliance risks	6	8	7	Internal failure within tariff server
35	2	CSMS gets tariffs from ADMS/ DERMS/utility	Latency in retrieving tariff information from server	Delayed transactions, user dissatisfaction	7	6	6.5	High query load
36	2	CSMS gets tariffs from ADMS/ DERMS/utility	Latency in retrieving tariff information from server	Delayed transactions, user dissatisfaction	7	6	6.5	Inefficient routing
37	2	CSMS gets tariffs from ADMS/ DERMS/utility	CSMS fails to update tariffs based on location-specific rules	Incorrect tariffs	6	8	7	Missed location-specific policy changes in tariff server
38	2	CSMS gets tariffs from ADMS/ DERMS/utility	CSMS fails to update tariffs based on location-specific rules	Regulatory noncompliance	6	9	7.5	Missed location-specific policy changes in tariff server
39	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariff applied, customer disputes (higher-than-ideal session cost)	5	5	5	Incorrect/ incomplete protocol implementation

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
40	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariff applied, customer disputes (higher-than-ideal session cost)	5	5	5	Data packet loss/corruption
41	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariff applied, customer disputes (higher-than-ideal session cost)	5	5	5	Internal failure within CSMS, encoding issues
42	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariff applied, customer disputes (higher-than-ideal session cost)	5	5	5	EVSE processing issue, decoding issues
43	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	6	7	6.5	Incorrect/ incomplete protocol implementation
44	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	6	7	6.5	Data packet loss/corruption
45	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	6	7	6.5	Internal failure within CSMS, encoding issues
46	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariffs applied, failure to flatten the curve	6	7	6.5	EVSE processing issue, decoding issues
47	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariff applied, legal risks	6	5	5.5	Incorrect/ incomplete protocol implementation
48	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariff applied, legal risks	6	5	5.5	Data packet loss/corruption
49	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariff applied, legal risks	6	5	5.5	Internal failure within CSMS, encoding issues
50	3	CSMS forwards tariff information to charge station/EVSE	Inaccurate tariffs	Wrong tariff applied, legal risks	6	5	5.5	EVSE processing issue, decoding issues
51	4	Initial EV-to-EVSE communication handshake (pre-V2G session)	EV/EVSE fail to establish a data link communication session	Failed charge session	8	1	4.5	Faulty hardware (PLC chip inside EV/EVSE)
52	4	Initial EV-to-EVSE communication handshake (pre-V2G session)	EV/EVSE fail to establish a data link communication session	Failed charge session	8	1	4.5	Incompatible protocols
53	4	Initial EV-to-EVSE communication handshake (pre-V2G session)	EV/EVSE fail to establish a data link communication session	Failed charge session	8	1	4.5	Connector issue

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
54	4	Initial EV-to-EVSE communication handshake (pre-V2G session)	EV/EVSE fail to establish a data link communication session	Failed charge session	**8**	**1**	**4.5**	Signal integrity issue (noise)
55	4	Initial EV-to-EVSE communication handshake (pre-V2G session)	EV/EVSE fail to establish a data link communication session	Failed charge session	**8**	**1**	**4.5**	Electric vehicle communications controller (EVCC) firmware crash
56	4	Initial EV-to-EVSE communication handshake (pre-V2G session)	EV/EVSE fail to establish a data link communication session	Failed charge session	**8**	**1**	**4.5**	Supply equipment communications controller (SECC) firmware crash
57	5	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**8**	**1**	**4.5**	Unstable connection/ communication loss
58	5	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**8**	**1**	**4.5**	Network congestion
59	5	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**8**	**1**	**4.5**	CSMS downtime
60	5	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**8**	**1**	**4.5**	Charger firmware crash
61	5	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	CSMS does not have accurate information about status of EVSE and its connector, sequence failure	**7**	**1**	**4**	Incorrect/ incomplete protocol implementation
62	5	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	CSMS does not have accurate information about status of EVSE and its connector, sequence failure	**7**	**1**	**4**	Data packet loss/corruption
63	5	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	CSMS does not have accurate information about status of EVSE and its connector, sequence failure	**7**	**1**	**4**	Internal failure within EVSE firmware, encoding issues
64	5	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	CSMS does not have accurate information about status of EVSE and its connector, sequence failure	**7**	**1**	**4**	CSMS processing issue, decoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
65	5	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, incorrect availability tracking	**6**	**7**	**6.5**	Incorrect/ incomplete protocol implementation
66	5	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, incorrect availability tracking	**6**	**7**	**6.5**	Data packet loss/corruption
67	5	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, incorrect availability tracking	**6**	**7**	**6.5**	Internal failure within EVSE firmware, encoding issues
68	5	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, incorrect availability tracking	**6**	**7**	**6.5**	CSMS processing issue, decoding issues
69	5	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, potential conflict error	**2**	**1**	**1.5**	Incorrect/ incomplete protocol implementation
70	5	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, potential conflict error	**2**	**1**	**1.5**	Data packet loss/corruption
71	5	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, potential conflict error	**2**	**1**	**1.5**	Internal failure within EVSE firmware, encoding issues
72	5	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, potential conflict error	**2**	**1**	**1.5**	CSMS processing issue, decoding issues
73	6	EVSE indicates the start of a new transaction to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**2**	**1**	**1.5**	Unstable connection/ communication loss
74	6	EVSE indicates the start of a new transaction to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**2**	**1**	**1.5**	Network congestion
75	6	EVSE indicates the start of a new transaction to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**2**	**1**	**1.5**	Charger firmware crash

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
76	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate eventType/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	2	1	1.5	Incorrect/ incomplete protocol implementation
77	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate eventType/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	2	1	1.5	Data packet loss/corruption
78	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate eventType/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	2	1	1.5	Internal failure within EVSE firmware, encoding issues
79	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate eventType/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	2	1	1.5	CSMS processing issue, decoding issues
80	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	7	9	8	Incorrect/ incomplete protocol implementation
81	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	7	9	8	Data packet loss/corruption
82	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	7	9	8	Internal failure within EVSE firmware, encoding issues
83	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	7	9	8	CSMS processing issue, decoding issues
84	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	2	1	1.5	Incorrect/ incomplete protocol implementation
85	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	2	1	1.5	Data packet loss/corruption
86	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	2	1	1.5	Internal failure within EVSE firmware, encoding issues
87	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	2	1	1.5	CSMS processing issue, decoding issues
88	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the transaction has not started	2	1	1.5	Intermittent data packet loss/corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
89	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the transaction has not started	**2**	**1**	**1.5**	Data packet loss/corruption
90	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the transaction has not started	**2**	**1**	**1.5**	Internal failure within EVSE firmware, encoding issues
91	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the transaction has not started	**2**	**1**	**1.5**	CSMS processing issue, decoding issues
92	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction started" to the wrong EVSE and connector, incorrect tracking	**2**	**1**	**1.5**	Incorrect/ incomplete protocol implementation
93	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction started" to the wrong EVSE and connector, incorrect tracking	**2**	**1**	**1.5**	Data packet loss/corruption
94	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction started" to the wrong EVSE and connector, incorrect tracking	**2**	**1**	**1.5**	Internal failure within EVSE firmware, encoding issues
95	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction started" to the wrong EVSE and connector, incorrect tracking	**2**	**1**	**1.5**	CSMS processing issue, decoding issues
96	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction started" to the wrong evseId, potential conflict error	**2**	**1**	**1.5**	Incorrect/ incomplete protocol implementation
97	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction started" to the wrong evseId, potential conflict error	**2**	**1**	**1.5**	Data packet loss/corruption
98	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction started" to the wrong evseId, potential conflict error	**2**	**1**	**1.5**	Internal failure within EVSE firmware, encoding issues
99	6	EVSE indicates the start of a new transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction started" to the wrong evseId, potential conflict error	**2**	**1**	**1.5**	CSMS processing issue, decoding issues
100	7	V2G session handshake	EV/EVSE fail to establish a successful V2G communication session	Failed charge session	**8**	**1**	**4.5**	Incorrect SDP/ESDP implementation in EVCC/SECC

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
101	7	V2G session handshake	EV/EVSE fail to establish a successful V2G communication session	Failed charge session	**8**	**1**	**4.5**	Signal integrity issue (noise)
102	7	V2G session handshake	EV/EVSE fail to establish a successful V2G communication session	Failed charge session	**8**	**1**	**4.5**	EVCC firmware crash
103	7	V2G session handshake	EV/EVSE fail to establish a successful V2G communication session	Failed charge session	**8**	**1**	**4.5**	SECC firmware crash
104	7	V2G session handshake	V2G communication session timeout (message/ sequence)	Failed charge session	**8**	**1**	**4.5**	Mismatch in thresholds for message/ sequence timeout
105	7	V2G session handshake	V2G communication session timeout (message/ sequence)	Failed charge session	**8**	**1**	**4.5**	EVCC processing bottlenecked
106	7	V2G session handshake	V2G communication session timeout (message/ sequence)	Failed charge session	**8**	**1**	**4.5**	SECC processing bottlenecked
107	7	V2G session handshake	Incompatible charger	Failed charge session	**8**	**1**	**4.5**	Incompatible application protocol
108	7	V2G session handshake	Incompatible charger	Failed charge session	**8**	**1**	**4.5**	Mismatch in supported energy transfer modes (single-phase/three-phase)
109	7	V2G session handshake	Incompatible charger	Failed charge session	**8**	**1**	**4.5**	Incorrect adapter used
110	7	V2G session handshake	Incompatible charger	Failed charge session	**8**	**1**	**4.5**	Internal failure within EVCC, encoding/ decoding issues
111	7	V2G session handshake	Incompatible charger	Failed charge session	**8**	**1**	**4.5**	Internal failure within SECC, encoding/ decoding issues
112	8	Payment authentication/ charge authorization	Failure to authenticate charge session	Failed charge session	**2**	**1**	**1.5**	Payment system is offline

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
113	8	Payment authentication/ charge authorization	Failure to authenticate charge session	Failed charge session	**2**	**1**	**1.5**	Expired/ incorrect certificates
114	8	Payment authentication/ charge authorization	Failure to authenticate charge session	Failed charge session	**2**	**1**	**1.5**	Charger is offline and cannot authenticate certificates
115	8	Payment authentication/ charge authorization	Failure to authenticate charge session	Failed charge session	**2**	**1**	**1.5**	CSMS takes too long to authenticate
116	8	Payment authentication/ charge authorization	Failure to authenticate charge session	Failed charge session	**2**	**1**	**1.5**	Backend server issue
117	8	Payment authentication/ charge authorization	Failure to authenticate charge session	Failed charge session	**2**	**1**	**1.5**	Faulty RFID/card reader
118	9	EVSE updates transaction status as "Authorized" to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**2**	**1**	**1.5**	Unstable connection/ communication loss
119	9	EVSE updates transaction status as "Authorized" to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**2**	**1**	**1.5**	Network congestion
120	9	EVSE updates transaction status as "Authorized" to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**2**	**1**	**1.5**	Charger firmware crash
121	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	**2**	**1**	**1.5**	Incorrect/ incomplete protocol implementation
122	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	**2**	**1**	**1.5**	Data packet loss/corruption
123	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	**2**	**1**	**1.5**	Internal failure within EVSE firmware, encoding issues
124	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	**2**	**1**	**1.5**	CSMS processing issue, decoding issues
125	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	**2**	**1**	**1.5**	Incorrect/ incomplete protocol implementation

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
126	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	**2**	**1**	**1.5**	Data packet loss/corruption
127	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	**2**	**1**	**1.5**	Internal failure within EVSE firmware, encoding issues
128	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	**2**	**1**	**1.5**	CSMS processing issue, decoding issues
129	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	**2**	**1**	**1.5**	Incorrect/ incomplete protocol implementation
130	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	**2**	**1**	**1.5**	Data packet loss/corruption
131	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	**2**	**1**	**1.5**	Internal failure within EVSE firmware, encoding issues
132	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	**2**	**1**	**1.5**	CSMS processing issue, decoding issues
133	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the transaction is not authorized	**2**	**1**	**1.5**	Intermittent data packet loss/corruption
134	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the transaction is not authorized	**2**	**1**	**1.5**	Data packet loss/corruption
135	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the transaction is not authorized	**2**	**1**	**1.5**	Internal failure within EVSE firmware, encoding issues
136	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the transaction is not authorized	**2**	**1**	**1.5**	CSMS processing issue, decoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
137	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Authorized" to the wrong EVSE and connector, incorrect tracking	2	7	4.5	Incorrect/ incomplete protocol implementation
138	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Authorized" to the wrong EVSE and connector, incorrect tracking	2	7	4.5	Data packet loss/corruption
139	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Authorized" to the wrong EVSE and connector, incorrect tracking	2	7	4.5	Internal failure within EVSE firmware, encoding issues
140	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Authorized" to the wrong EVSE and connector, incorrect tracking	2	7	4.5	CSMS processing issue, decoding issues
141	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate evseId/ connectorId	CSMS assigns EV's charging needs to the wrong evseId, potential conflict error	2	1	1.5	Incorrect/ incomplete protocol implementation
142	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate evseId/ connectorId	CSMS assigns EV's charging needs to the wrong evseId, potential conflict error	2	1	1.5	Data packet loss/corruption
143	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate evseId/ connectorId	CSMS assigns EV's charging needs to the wrong evseId, potential conflict error	2	1	1.5	Internal failure within EVSE firmware, encoding issues
144	9	EVSE updates transaction status as "Authorized" to CSMS	Inaccurate evseId/ connectorId	CSMS assigns EV's charging needs to the wrong evseId, potential conflict error	2	1	1.5	CSMS processing issue, decoding issues
145	10	EVSE forwards EV's charging needs to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Unstable connection/ communication loss
146	10	EVSE forwards EV's charging needs to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Network congestion
147	10	EVSE forwards EV's charging needs to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Charger firmware crash
148	10	EVSE forwards EV's charging needs to CSMS	Inaccurate evseId	CSMS assigns EV's charging needs to the wrong evseId, incorrect tracking	7	7	7	Incorrect/ incomplete protocol implementation
149	10	EVSE forwards EV's charging needs to CSMS	Inaccurate evseId	CSMS assigns EV's charging needs to the wrong evseId, incorrect tracking	7	7	7	Data packet loss/corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
150	10	EVSE forwards EV's charging needs to CSMS	Inaccurate evseId	CSMS assigns EV's charging needs to the wrong evseId, incorrect tracking	7	7	7	Internal failure within EVSE firmware, encoding issues
151	10	EVSE forwards EV's charging needs to CSMS	Inaccurate evseId	CSMS assigns EV's charging needs to the wrong evseId, incorrect tracking	7	7	7	CSMS processing issue, decoding issues
152	10	EVSE forwards EV's charging needs to CSMS	Inaccurate evseId	CSMS assigns EV's charging needs to the wrong evseId, potential conflict error	7	7	7	Incorrect/ incomplete protocol implementation
153	10	EVSE forwards EV's charging needs to CSMS	Inaccurate evseId	CSMS assigns EV's charging needs to the wrong evseId, potential conflict error	7	7	7	Data packet loss/corruption
154	10	EVSE forwards EV's charging needs to CSMS	Inaccurate evseId	CSMS assigns EV's charging needs to the wrong evseId, potential conflict error	7	7	7	Internal failure within EVSE firmware, encoding issues
155	10	EVSE forwards EV's charging needs to CSMS	Inaccurate evseId	CSMS assigns EV's charging needs to the wrong evseId, potential conflict error	7	7	7	CSMS processing issue, decoding issues
156	11	EV and EVSE charge negotiation (charge schedule and tariffs)	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	Signal integrity issue (noise)
157	11	EV and EVSE charge negotiation (charge schedule and tariffs)	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	EVCC firmware crash
158	11	EV and EVSE charge negotiation (charge schedule and tariffs)	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	SECC firmware crash
159	11	EV and EVSE charge negotiation (charge schedule and tariffs)	Inaccurate tariffs communicated by SECC	Wrong tariff applied, customer disputes (higher-than-ideal session cost)	5	5	5	Incorrect protocol implementation
160	11	EV and EVSE charge negotiation (charge schedule and tariffs)	Inaccurate tariffs communicated by SECC	Wrong tariff applied, customer disputes (higher-than-ideal session cost)	5	5	5	Data packet loss/corruption
161	11	EV and EVSE charge negotiation (charge schedule and tariffs)	Inaccurate tariffs communicated by SECC	Wrong tariff applied, customer disputes (higher-than-ideal session cost)	5	5	5	Encoding issues in EVCC
162	11	EV and EVSE charge negotiation (charge schedule and tariffs)	Inaccurate tariffs communicated by SECC	Wrong tariff applied, customer disputes (higher-than-ideal session cost)	5	5	5	Decoding issues in SECC
163	11	EV and EVSE charge negotiation (charge schedule and tariffs)	Inaccurate tariffs communicated by SECC	Wrong tariff applied, failure to flatten the curve	5	7	6	Incorrect protocol implementation

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
164	11	EV and EVSE charge negotiation (charge schedule and tariffs)	Inaccurate tariffs communicated by SECC	Wrong tariff applied, failure to flatten the curve	5	7	6	Data packet loss/corruption
165	11	EV and EVSE charge negotiation (charge schedule and tariffs)	Inaccurate tariffs communicated by SECC	Wrong tariff applied, failure to flatten the curve	5	7	6	Encoding issues in EVCC
166	11	EV and EVSE charge negotiation (charge schedule and tariffs)	Inaccurate tariffs communicated by SECC	Wrong tariff applied, failure to flatten the curve	5	7	6	Decoding issues in SECC
167	11	EV and EVSE charge negotiation (charge schedule and tariffs)	V2G communication session timeout (message/ sequence)	Failed charge session	8	2	5	Mismatch in thresholds for message/ sequence timeout
168	11	EV and EVSE charge negotiation (charge schedule and tariffs)	V2G communication session timeout (message/ sequence)	Failed charge session	8	2	5	EVCC processing bottlenecked
169	11	EV and EVSE charge negotiation (charge schedule and tariffs)	V2G communication session timeout (message/ sequence)	Failed charge session	8	2	5	SECC processing bottlenecked
170	12	EV calculates optimized charging schedule based on tariffs	Nonoptimal charge power schedule calculated by EV	User needs are met but has to pay higher-than-optimal rate	5	5	5	SCM optimization algorithm failure
171	12	EV calculates optimized charging schedule based on tariffs	Nonoptimal charge power schedule calculated by EV	User needs are not met by intended departure time	7	4	5.5	SCM optimization algorithm failure
172	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	User has to pay higher-than-optimal rate	5	2	3.5	EV does not support pause
173	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	User has to pay higher-than-optimal rate	5	2	3.5	EVSE does not support pause
174	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	User has to pay higher-than-optimal rate	5	2	3.5	Incorrect/ incomplete protocol implementation in EVCC
175	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	User has to pay higher-than-optimal rate	5	2	3.5	Incorrect/ incomplete protocol implementation in SECC
176	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	Failed charge session	8	2	5	Signal integrity issue (noise)

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
177	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	Failed charge session	8	2	5	EVCC firmware crash
178	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	Failed charge session	8	2	5	SECC firmware crash
179	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	Failed charge session	8	2	5	Incorrect/ incomplete protocol implementation in EVCC
180	13	Optional step where EV pauses session to wait for optimal time to charge	Unsuccessful session pause	Failed charge session	8	2	5	Incorrect/ incomplete protocol implementation in SECC
181	13	Optional step where EV pauses session to wait for optimal time to charge	EVSE assumes EV disconnected instead of sleeping	Charging session terminates instead of pausing	8	2	5	Incorrect/ incomplete protocol implementation
182	13	Optional step where EV pauses session to wait for optimal time to charge	EVSE assumes EV disconnected instead of sleeping	Charging session terminates instead of pausing	8	2	5	EVSE does not support pause
183	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not go to sleep	EV battery drain, user unable to operate vehicle	9	2	5.5	Conditions for sleep not met
184	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not go to sleep	EV battery drain, user unable to operate vehicle	9	2	5.5	EV does not support going to sleep when connector is plugged in
185	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not go to sleep	EV battery drain, user unable to operate vehicle	9	2	5.5	EVCC software bug
186	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not go to sleep	User charging needs are not met	7	4	5.5	Conditions for sleep not met
187	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not go to sleep	User charging needs are not met	7	4	5.5	EV does not support going to sleep when connector is plugged in
188	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not go to sleep	User charging needs are not met	7	4	5.5	EVCC software bug

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
189	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not wake up	User charging needs are not met	8	2	5	EVCC software bug
190	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not wake up	User charging needs are not met	8	2	5	Internal error
191	13	Optional step where EV pauses session to wait for optimal time to charge	EV does not wake up	User charging needs are not met	8	2	5	Internal timer failure
192	13	Optional step where EV pauses session to wait for optimal time to charge	EV unable to "wake up" EVSE	User charging needs are not met	8	2	5	EVSE does not support pilot wake
193	13	Optional step where EV pauses session to wait for optimal time to charge	EV unable to "wake up" EVSE	User charging needs are not met	8	2	5	Mismatch in restart mechanisms between EV and EVSE
194	13	Optional step where EV pauses session to wait for optimal time to charge	EV unable to "wake up" EVSE	User charging needs are not met	8	2	5	Session not paused gracefully, EV ignores wake stimulus
195	13	Optional step where EV pauses session to wait for optimal time to charge	EV unable to "wake up" EVSE	User charging needs are not met	8	2	5	SECC software bug
196	13	Optional step where EV pauses session to wait for optimal time to charge	EVCC does not re-initialize the session using the previous SessionID, payment options, or SAScheduleTuple	SECC goes into an error state and does not allow a new session without a re-plug	8	2	5	Incorrect/ incomplete protocol implementation
197	13	Optional step where EV pauses session to wait for optimal time to charge	EVCC does not re-initialize the session using the previous SessionID, payment options, or SAScheduleTuple	SECC goes into an error state and does not allow a new session without a re-plug	8	2	5	Data packet loss/corruption
198	13	Optional step where EV pauses session to wait for optimal time to charge	EVCC does not re-initialize the session using the previous SessionID, payment options, or SAScheduleTuple	SECC goes into an error state and does not allow a new session without a re-plug	8	2	5	Encoding issues in EVCC

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
199	13	Optional step where EV pauses session to wait for optimal time to charge	EVCC does not re-initialize the session using the previous SessionID, payment options, or SAScheduleTuple	SECC goes into an error state and does not allow a new session without a re-plug	8	2	5	Decoding issues in SECC
200	13	Optional step where EV pauses session to wait for optimal time to charge	EV wakes up at the wrong time	User has to pay higher-than-optimal rate	5	7	6	Internal timer failure
201	13	Optional step where EV pauses session to wait for optimal time to charge	EV wakes up at the wrong time	User has to pay higher-than-optimal rate	5	7	6	EVCC software bug
202	13	Optional step where EV pauses session to wait for optimal time to charge	EV wakes up at the wrong time	User has to pay higher-than-optimal rate	5	7	6	EV clock drift/ not synchronized
203	14	EVSE forwards EV's charge schedule for the session to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Unstable connection/ communication loss
204	14	EVSE forwards EV's charge schedule for the session to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Network congestion
205	14	EVSE forwards EV's charge schedule for the session to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Charger firmware crash
206	14	EVSE forwards EV's charge schedule for the session to CSMS	Lower-than-actual charging schedule is communicated	CSMS may communicate a higher available power schedule to other EVSE, grid overload/safety issue	1	6	3.5	Incorrect/ incomplete protocol implementation
207	14	EVSE forwards EV's charge schedule for the session to CSMS	Lower-than-actual charging schedule is communicated	CSMS may communicate a higher available power schedule to other EVSE, grid overload/safety issue	1	6	3.5	Data packet loss/corruption
208	14	EVSE forwards EV's charge schedule for the session to CSMS	Lower-than-actual charging schedule is communicated	CSMS may communicate a higher available power schedule to other EVSE, grid overload/safety issue	1	6	3.5	Internal failure within EVSE firmware, encoding issues
209	14	EVSE forwards EV's charge schedule for the session to CSMS	Lower-than-actual charging schedule is communicated	CSMS may communicate a higher available power schedule to other EVSE, grid overload/safety issue	1	6	3.5	CSMS processing issue, decoding issues
210	14	EVSE forwards EV's charge schedule for the session to CSMS	Higher-than-actual charging schedule is communicated	CSMS communicates a lower available power schedule to other EVSE, suboptimal SCM performance for other EVs	1	4	2.5	Incorrect/ incomplete protocol implementation

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
211	14	EVSE forwards EV's charge schedule for the session to CSMS	Higher-than-actual charging schedule is communicated	CSMS communicates a lower available power schedule to other EVSE, suboptimal SCM performance for other EVs	1	4	2.5	Data packet loss/corruption
212	14	EVSE forwards EV's charge schedule for the session to CSMS	Higher-than-actual charging schedule is communicated	CSMS communicates a lower available power schedule to other EVSE, suboptimal SCM performance for other EVs	1	4	2.5	Internal failure within EVSE firmware, encoding issues
213	14	EVSE forwards EV's charge schedule for the session to CSMS	Higher-than-actual charging schedule is communicated	CSMS communicates a lower available power schedule to other EVSE, suboptimal SCM performance for other EVs	1	4	2.5	CSMS processing issue, decoding issues
214	15	EVSE indicates start of energy transfer to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Unstable connection/ communication loss
215	15	EVSE indicates start of energy transfer to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Network congestion
216	15	EVSE indicates start of energy transfer to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Charger firmware crash
217	15	EVSE indicates start of energy transfer to CSMS	Inaccurate eventType/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	8	2	5	Incorrect/ incomplete protocol implementation
218	15	EVSE indicates start of energy transfer to CSMS	Inaccurate eventType/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	8	2	5	Data packet loss/corruption
219	15	EVSE indicates start of energy transfer to CSMS	Inaccurate eventType/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	8	2	5	Internal failure within EVSE firmware, encoding issues
220	15	EVSE indicates start of energy transfer to CSMS	Inaccurate eventType/ triggerReason	CSMS does not have accurate status of the transaction, sequence failure	8	2	5	CSMS processing issue, decoding issues
221	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	8	6	7	Incorrect/ incomplete protocol implementation
222	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	8	6	7	Data packet loss/corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
223	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	8	6	7	Internal failure within EVSE firmware, encoding issues
224	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	8	6	7	CSMS processing issue, decoding issues
225	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	8	2	5	Incorrect/ incomplete protocol implementation
226	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	8	2	5	Data packet loss/corruption
227	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	8	2	5	Internal failure within EVSE firmware, encoding issues
228	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	8	2	5	CSMS processing issue, decoding issues
229	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks energy transfer has not started	8	2	5	Intermittent data packet loss/corruption
230	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks energy transfer has not started	8	2	5	Data packet loss/corruption
231	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks energy transfer has not started	8	2	5	Internal failure within EVSE firmware, encoding issues
232	15	EVSE indicates start of energy transfer to CSMS	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks energy transfer has not started	8	2	5	CSMS processing issue, decoding issues
233	15	EVSE indicates start of energy transfer to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Charging started" to the wrong evseId, potential conflict error	8	2	5	Incorrect/ incomplete protocol implementation
234	15	EVSE indicates start of energy transfer to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Charging started" to the wrong evseId, potential conflict error	8	2	5	Data packet loss/corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
235	15	EVSE indicates start of energy transfer to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Charging started" to the wrong evseId, potential conflict error	8	2	5	Internal failure within EVSE firmware, encoding issues
236	15	EVSE indicates start of energy transfer to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Charging started" to the wrong evseId, potential conflict error	8	2	5	CSMS processing issue, decoding issues
237	16	EV-EVSE communications during energy transfer (includes metering receipt)	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	Signal integrity issue (noise)
238	16	EV-EVSE communications during energy transfer (includes metering receipt)	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	EVCC firmware crash
239	16	EV-EVSE communications during energy transfer (includes metering receipt)	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	SECC firmware crash
240	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (higher than actual)	Grid overload/ safety issue	10	10	10	Incorrect protocol implementation
241	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (higher than actual)	Grid overload/ safety issue	10	10	10	Data packet loss/corruption
242	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (higher than actual)	Grid overload/ safety issue	10	10	10	Encoding issues in SECC
243	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (higher than actual)	Grid overload/ safety issue	10	10	10	Decoding issues in EVCC
244	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (lower than actual)	User needs not met	7	4	5.5	Incorrect protocol implementation
245	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (lower than actual)	User needs not met	7	4	5.5	Data packet loss/corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
246	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (lower than actual)	User needs not met	7	4	5.5	Encoding issues in SECC
247	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (lower than actual)	User needs not met	7	4	5.5	Decoding issues in EVCC
248	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (lower than actual)	Inefficient charging (time)	5	4	4.5	Incorrect protocol implementation
249	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (lower than actual)	Inefficient charging (time)	5	4	4.5	Data packet loss/corruption
250	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (lower than actual)	Inefficient charging (time)	5	4	4.5	Encoding issues in SECC
251	16	EV-EVSE communications during energy transfer (includes metering receipt)	Inaccurate maximum current communicated by EVSE (lower than actual)	Inefficient charging (time)	5	4	4.5	Decoding issues in EVCC
252	16	EV-EVSE communications during energy transfer (includes metering receipt)	Invalid ChargingStatusRes message	EVSE does not indicate that signed receipt is required, EV does not sign meter receipt	4	6	5	Incorrect protocol implementation
253	16	EV-EVSE communications during energy transfer (includes metering receipt)	Invalid ChargingStatusRes message	EVSE does not indicate that signed receipt is required, EV does not sign meter receipt	4	6	5	Data packet loss/corruption
254	16	EV-EVSE communications during energy transfer (includes metering receipt)	Invalid ChargingStatusRes message	EVSE does not indicate that signed receipt is required, EV does not sign meter receipt	4	6	5	Encoding issues in SECC
255	16	EV-EVSE communications during energy transfer (includes metering receipt)	Invalid ChargingStatusRes message	EVSE does not indicate that signed receipt is required, EV does not sign meter receipt	4	6	5	Decoding issues in EVCC
256	17	EVSE forwards signed meter values to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	8	2	5	Unstable connection/ communication loss

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
257	17	EVSE forwards signed meter values to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**8**	**2**	**5**	Network congestion
258	17	EVSE forwards signed meter values to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**8**	**2**	**5**	Charger firmware crash
259	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, intermittent	CSMS intermittently misses meter value, inaccurate session cost charge to user and/or revenue loss (depends on measurand type)	**4**	**4**	**4**	Incorrect/ incomplete protocol implementation
260	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, intermittent	CSMS intermittently misses meter value, inaccurate session cost charge to user and/or revenue loss (depends on measurand type)	**4**	**4**	**4**	Data packet loss/corruption
261	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, intermittent	CSMS intermittently misses meter value, inaccurate session cost charge to user and/or revenue loss (depends on measurand type)	**4**	**4**	**4**	Internal failure within EVSE firmware, encoding issues
262	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, intermittent	CSMS intermittently misses meter value, inaccurate session cost charge to user and/or revenue loss (depends on measurand type)	**4**	**4**	**4**	CSMS processing issue, decoding issues
263	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, persistent	CSMS misses meter value, falls back to other sources of metering information	**1**	**4**	**2.5**	Incorrect/ incomplete protocol implementation
264	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, persistent	CSMS misses meter value, falls back to other sources of metering information	**1**	**4**	**2.5**	Data packet loss/corruption
265	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, persistent	CSMS misses meter value, falls back to other sources of metering information	**1**	**4**	**2.5**	Internal failure within EVSE firmware, encoding issues
266	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, persistent	CSMS misses meter value, falls back to other sources of metering information	**1**	**4**	**2.5**	CSMS processing issue, decoding issues
267	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, persistent	CSMS misses meter value and has no fallback sources for metering information	**8**	**6**	**7**	Incorrect/ incomplete protocol implementation

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
268	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, persistent	CSMS misses meter value and has no fallback sources for metering information	8	6	7	Data packet loss/corruption
269	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, persistent	CSMS misses meter value and has no fallback sources for metering information	8	6	7	Internal failure within EVSE firmware, encoding issues
270	17	EVSE forwards signed meter values to CSMS	Inaccurate eventType/ triggerReason, persistent	CSMS misses meter value and has no fallback sources for metering information	8	6	7	CSMS processing issue, decoding issues
271	17	EVSE forwards signed meter values to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, user overcharged compared to actual session cost, legal liability	8	7	7.5	Incorrect/ incomplete protocol implementation
272	17	EVSE forwards signed meter values to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, user overcharged compared to actual session cost, legal liability	8	7	7.5	Data packet loss/corruption
273	17	EVSE forwards signed meter values to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, user overcharged compared to actual session cost, legal liability	8	7	7.5	Internal failure within EVSE firmware, encoding issues
274	17	EVSE forwards signed meter values to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, user overcharged compared to actual session cost, legal liability	8	7	7.5	CSMS processing issue, decoding issues
275	17	EVSE forwards signed meter values to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Meter Values" to the wrong EVSE and connector, user overcharged compared to actual session cost, legal liability	8	6	7	Incorrect/ incomplete protocol implementation
276	17	EVSE forwards signed meter values to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Meter Values" to the wrong EVSE and connector, user overcharged compared to actual session cost, legal liability	8	6	7	Data packet loss/corruption
277	17	EVSE forwards signed meter values to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Meter Values" to the wrong EVSE and connector, user overcharged compared to actual session cost, legal liability	8	6	7	Internal failure within EVSE firmware, encoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
278	17	EVSE forwards signed meter values to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Meter Values" to the wrong EVSE and connector, user overcharged compared to actual session cost, legal liability	8	6	7	CSMS processing issue, decoding issues
279	17	EVSE forwards signed meter values to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Meter Values" to the wrong EVSE and connector, user undercharged compared to actual session cost, revenue loss	8	4	6	Incorrect/ incomplete protocol implementation
280	17	EVSE forwards signed meter values to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Meter Values" to the wrong EVSE and connector, user undercharged compared to actual session cost, revenue loss	8	4	6	Data packet loss/corruption
281	17	EVSE forwards signed meter values to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Meter Values" to the wrong EVSE and connector, user undercharged compared to actual session cost, revenue loss	8	4	6	Internal failure within EVSE firmware, encoding issues
282	17	EVSE forwards signed meter values to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Meter Values" to the wrong EVSE and connector, user undercharged compared to actual session cost, revenue loss	8	4	6	CSMS processing issue, decoding issues
283	17	EVSE forwards signed meter values to CSMS	Inaccurate meter information	User overcharged compared to actual session cost, legal liability	6	6	6	Incorrect/ incomplete protocol implementation
284	17	EVSE forwards signed meter values to CSMS	Inaccurate meter information	User overcharged compared to actual session cost, legal liability	6	6	6	Data packet loss/corruption
285	17	EVSE forwards signed meter values to CSMS	Inaccurate meter information	User overcharged compared to actual session cost, legal liability	6	6	6	Internal failure within EVSE firmware, encoding issues
286	17	EVSE forwards signed meter values to CSMS	Inaccurate meter information	User overcharged compared to actual session cost, legal liability	6	6	6	CSMS processing issue, decoding issues
287	17	EVSE forwards signed meter values to CSMS	Inaccurate meter information	User undercharged compared to actual session cost, revenue loss	4	4	4	Incorrect/ incomplete protocol implementation
288	17	EVSE forwards signed meter values to CSMS	Inaccurate meter information	User undercharged compared to actual session cost, revenue loss	4	4	4	Data packet loss/corruption

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
289	17	EVSE forwards signed meter values to CSMS	Inaccurate meter information	User undercharged compared to actual session cost, revenue loss	4	4	4	Internal failure within EVSE firmware, encoding issues
290	17	EVSE forwards signed meter values to CSMS	Inaccurate meter information	User undercharged compared to actual session cost, revenue loss	4	4	4	CSMS processing issue, decoding issues
291	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS falls back to other sources of metering information	1	1	1	Incorrect/ incomplete protocol implementation
292	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS falls back to other sources of metering information	1	1	1	Invalid signature
293	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS falls back to other sources of metering information	1	1	1	Data packet loss/corruption
294	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS falls back to other sources of metering information	1	1	1	Internal failure within EVSE firmware, encoding issues
295	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS falls back to other sources of metering information	1	1	1	CSMS processing issue, decoding issues
296	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS has no fallback sources for metering information	8	6	7	Incorrect/ incomplete protocol implementation
297	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS has no fallback sources for metering information	8	6	7	Invalid signature
298	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS has no fallback sources for metering information	8	6	7	Data packet loss/corruption
299	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS has no fallback sources for metering information	8	6	7	Internal failure within EVSE firmware, encoding issues
300	17	EVSE forwards signed meter values to CSMS	CSMS cannot authenticate signature	CSMS has no fallback sources for metering information	8	6	7	CSMS processing issue, decoding issues
301	18	Renegotiate V2G session	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	Signal integrity issue (noise)
302	18	Renegotiate V2G session	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	EVCC firmware crash

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
303	18	Renegotiate V2G session	EV and EVSE cannot reliably communicate with each other	Failed charge session	8	2	5	SECC firmware crash
304	18	Renegotiate V2G session	Failed to initiate renegotiation	Charging session ends, user needs not met	8	2	5	Data packet loss/corruption
305	18	Renegotiate V2G session	Failed to initiate renegotiation	Charging session ends, user needs not met	8	2	5	EVCC/SECC does not support renegotiation
306	18	Renegotiate V2G session	Failed to initiate renegotiation	Charging session ends, user needs not met	8	2	5	Incorrect/ incomplete protocol implementation
307	18	Renegotiate V2G session	Failed to initiate renegotiation	Charging session ends, user needs not met	8	2	5	Encoding/ decoding issues with EVCC/SECC
308	19	EVSE informs CSMS about the end of energy transfer	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	3	3	3	Unstable connection/ communication loss
309	19	EVSE informs CSMS about the end of energy transfer	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	3	3	3	Network congestion
310	19	EVSE informs CSMS about the end of energy transfer	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	3	3	3	Charger firmware crash
311	19	EVSE informs CSMS about the end of energy transfer	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, incorrect tracking/sequence failure	6	6	6	Incorrect/ incomplete protocol implementation
312	19	EVSE informs CSMS about the end of energy transfer	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, incorrect tracking/sequence failure	6	6	6	Data packet loss/corruption
313	19	EVSE informs CSMS about the end of energy transfer	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, incorrect tracking/sequence failure	6	6	6	Internal failure within EVSE firmware, encoding issues
314	19	EVSE informs CSMS about the end of energy transfer	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, incorrect tracking/sequence failure	6	6	6	CSMS processing issue, decoding issues
315	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	3	6	4.5	Incorrect/ incomplete protocol implementation
316	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	3	6	4.5	Data packet loss/corruption
317	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	3	6	4.5	Internal failure within EVSE firmware, encoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
318	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	3	6	4.5	CSMS processing issue, decoding issues
319	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	3	3	3	Incorrect/ incomplete protocol implementation
320	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	3	3	3	Data packet loss/corruption
321	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	3	3	3	Internal failure within EVSE firmware, encoding issues
322	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	3	3	3	CSMS processing issue, decoding issues
323	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the energy transfer is still ongoing	3	3	3	Intermittent data packet loss/corruption
324	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the energy transfer is still ongoing	3	3	3	Data packet loss/corruption
325	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the energy transfer is still ongoing	3	3	3	Internal failure within EVSE firmware, encoding issues
326	19	EVSE informs CSMS about the end of energy transfer	Inaccurate transactionId	CSMS may go into an error state when it receives the next "happy path" message because it thinks the energy transfer is still ongoing	3	3	3	CSMS processing issue, decoding issues
327	19	EVSE informs CSMS about the end of energy transfer	Inaccurate evseId/ connectorId	CSMS assigns "EV Connected" to the wrong EVSE and connector, incorrect tracking	3	6	4.5	Incorrect/ incomplete protocol implementation
328	19	EVSE informs CSMS about the end of energy transfer	Inaccurate evseId/ connectorId	CSMS assigns "EV Connected" to the wrong EVSE and connector, incorrect tracking	3	6	4.5	Data packet loss/corruption
329	19	EVSE informs CSMS about the end of energy transfer	Inaccurate evseId/ connectorId	CSMS assigns "EV Connected" to the wrong EVSE and connector, incorrect tracking	3	6	4.5	Internal failure within EVSE firmware, encoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
330	19	EVSE informs CSMS about the end of energy transfer	Inaccurate evseId/ connectorId	CSMS assigns "EV Connected" to the wrong EVSE and connector, incorrect tracking	3	6	4.5	CSMS processing issue, decoding issues
331	19	EVSE informs CSMS about the end of energy transfer	Inaccurate evseId/ connectorId	CSMS assigns "EV Connected" to the wrong EVSE and connector, potential conflict error	3	3	3	Incorrect/ incomplete protocol implementation
332	19	EVSE informs CSMS about the end of energy transfer	Inaccurate evseId/ connectorId	CSMS assigns "EV Connected" to the wrong EVSE and connector, potential conflict error	3	3	3	Data packet loss/corruption
333	19	EVSE informs CSMS about the end of energy transfer	Inaccurate evseId/ connectorId	CSMS assigns "EV Connected" to the wrong EVSE and connector, potential conflict error	3	3	3	Internal failure within EVSE firmware, encoding issues
334	19	EVSE informs CSMS about the end of energy transfer	Inaccurate evseId/ connectorId	CSMS assigns "EV Connected" to the wrong EVSE and connector, potential conflict error	3	3	3	CSMS processing issue, decoding issues
335	20	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	3	3	3	Unstable connection/ communication loss
336	20	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	3	3	3	Network congestion
337	20	EVSE updates its status to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	3	3	3	Charger firmware crash
338	20	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	EVSE communicates inaccurate connector status to CSMS, sequence failure	3	3	3	Incorrect/ incomplete protocol implementation
339	20	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	EVSE communicates inaccurate connector status to CSMS, sequence failure	3	3	3	Data packet loss/corruption
340	20	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	EVSE communicates inaccurate connector status to CSMS, sequence failure	3	3	3	Internal failure within EVSE firmware, encoding issues
341	20	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	EVSE communicates inaccurate connector status to CSMS, sequence failure	3	3	3	CSMS processing issue, decoding issues
342	20	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	EVSE communicates inaccurate connector status to CSMS, incorrect availability tracking	3	3	3	Incorrect/ incomplete protocol implementation

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
343	20	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	EVSE communicates inaccurate connector status to CSMS, incorrect availability tracking	3	3	3	Data packet loss/corruption
344	20	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	EVSE communicates inaccurate connector status to CSMS, incorrect availability tracking	3	3	3	Internal failure within EVSE firmware, encoding issues
345	20	EVSE updates its status to CSMS	Inaccurate connectorStatus communicated	EVSE communicates inaccurate connector status to CSMS, incorrect availability tracking	3	3	3	CSMS processing issue, decoding issues
346	20	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, incorrect availability tracking	3	6	4.5	Incorrect/ incomplete protocol implementation
347	20	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, incorrect availability tracking	3	6	4.5	Data packet loss/corruption
348	20	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, incorrect availability tracking	3	6	4.5	Internal failure within EVSE firmware, encoding issues
349	20	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, incorrect availability tracking	3	6	4.5	CSMS processing issue, decoding issues
350	20	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, potential conflict error	3	6	4.5	Incorrect/ incomplete protocol implementation
351	20	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, potential conflict error	3	6	4.5	Data packet loss/corruption
352	20	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, potential conflict error	3	6	4.5	Internal failure within EVSE firmware, encoding issues
353	20	EVSE updates its status to CSMS	Inaccurate evseId/ connectorID	CSMS assigns connectorStatus to the wrong EVSE and connector, potential conflict error	3	6	4.5	CSMS processing issue, decoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
354	21	EVSE indicates the end of transaction to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**3**	**3**	**3**	Unstable connection/ communication loss
355	21	EVSE indicates the end of transaction to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**3**	**3**	**3**	Network congestion
356	21	EVSE indicates the end of transaction to CSMS	CSMS and EVSE cannot reliably communicate with each other	Failed charge session **ONLY** if EVSE is not configured to charge in offline mode	**3**	**3**	**3**	Charger firmware crash
357	21	EVSE indicates the end of transaction to CSMS	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, incorrect tracking/sequence failure	**3**	**3**	**3**	Incorrect/ incomplete protocol implementation
358	21	EVSE indicates the end of transaction to CSMS	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, incorrect tracking/sequence failure	**3**	**3**	**3**	Data packet loss/corruption
359	21	EVSE indicates the end of transaction to CSMS	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, incorrect tracking/sequence failure	**3**	**3**	**3**	Internal failure within EVSE firmware, encoding issues
360	21	EVSE indicates the end of transaction to CSMS	Inaccurate chargingState/ triggerReason	CSMS does not have accurate status of the transaction, incorrect tracking/sequence failure	**3**	**3**	**3**	CSMS processing issue, decoding issues
361	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	**3**	**6**	**4.5**	Incorrect/ incomplete protocol implementation
362	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	**3**	**6**	**4.5**	Data packet loss/corruption
363	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	**3**	**6**	**4.5**	Internal failure within EVSE firmware, encoding issues
364	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, incorrect tracking	**3**	**6**	**4.5**	CSMS processing issue, decoding issues
365	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	**3**	**3**	**3**	Incorrect/ incomplete protocol implementation
366	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	**3**	**3**	**3**	Data packet loss/corruption
367	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	**3**	**3**	**3**	Internal failure within EVSE firmware, encoding issues

ID	Seq #	Process Step/Function	Potential Failure Modes	Potential Effects of Failure	Customer Severity	Utility Severity	Overall Severity (Avg.)	Potential Cause of Failure
368	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS tracks status of the wrong TransactionId, potential conflict error	3	3	3	CSMS processing issue, decoding issues
369	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS is not aware that the transaction has ended and can cause a conflict with the next transaction on that EVSE	3	3	3	Intermittent data packet loss/corruption
370	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS is not aware that the transaction has ended and can cause a conflict with the next transaction on that EVSE	3	3	3	Data packet loss/corruption
371	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS is not aware that the transaction has ended and can cause a conflict with the next transaction on that EVSE	3	3	3	Internal failure within EVSE firmware, encoding issues
372	21	EVSE indicates the end of transaction to CSMS	Inaccurate transactionId	CSMS is not aware that the transaction has ended and can cause a conflict with the next transaction on that EVSE	3	3	3	CSMS processing issue, decoding issues
373	21	EVSE indicates the end of transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction Ended" to the wrong EVSE and connector, incorrect tracking	3	6	4.5	Incorrect/ incomplete protocol implementation
374	21	EVSE indicates the end of transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction Ended" to the wrong EVSE and connector, incorrect tracking	3	6	4.5	Data packet loss/corruption
375	21	EVSE indicates the end of transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction Ended" to the wrong EVSE and connector, incorrect tracking	3	6	4.5	Internal failure within EVSE firmware, encoding issues
376	21	EVSE indicates the end of transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction Ended" to the wrong EVSE and connector, incorrect tracking	3	6	4.5	CSMS processing issue, decoding issues
377	21	EVSE indicates the end of transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction Ended" to the wrong EVSE and connector, potential conflict error	3	3	3	Incorrect/ incomplete protocol implementation
378	21	EVSE indicates the end of transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction Ended" to the wrong EVSE and connector, potential conflict error	3	3	3	Data packet loss/corruption
379	21	EVSE indicates the end of transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction Ended" to the wrong EVSE and connector, potential conflict error	3	3	3	Internal failure within EVSE firmware, encoding issues
380	21	EVSE indicates the end of transaction to CSMS	Inaccurate evseId/ connectorId	CSMS assigns "Transaction Ended" to the wrong EVSE and connector, potential conflict error	3	3	3	CSMS processing issue, decoding issues

CHARGEX
consortium

About the ChargeX Consortium

The National Charging Experience Consortium (ChargeX Consortium) is a collaborative effort between Argonne National Laboratory, Idaho National Laboratory, National Laboratory of the Rockies, electric vehicle charging industry experts, consumer advocates, and other stakeholders. The ChargeX Consortium's mission is to work together to measure and significantly improve public charging reliability and usability by June 2025. For more information, visit chargex.inl.gov.

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