Feature Document (FD)

Power Open/Close Liftgate Feature

(F000162)

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1 INTRODUCTION

1.1 Document Purpose

A Feature Document (FD) document specifies **what** the feature shall do and how it shall behave from customer perspective. It should also provide reasoning and background **why** we have the feature in the vehicle.

The FD also serves as an Item Definition as defined by ISO26262 for those features, which follow the Ford Functional Safety process.

To get more information about the concept of feature, function and component level abstraction refer to the Ford RE Wiki. For details on the Ford Functional Safety (ISO26262) process refer to the Ford Functional Safety Sharepoint.

1.2 Document Scope

This Feature Document (FD) specifies the following features:

Feature ID	Feature Name	Owner	Reference
F000162			https://www.vsemweb.ford.com/tc/launchapp?-attach=true&-s=226TCSession&-o=jAd9HPXnx3NrTDAAAAAAAAAAAAA&servername=Production_Server

Table 1: Features described in this FD

1.3 Document Audience

The FD is written by the feature owner of <Feature / Feature Group Name>. All Stakeholders, i.e., all people who have a valid interest in the feature should read and, if possible, review the FD. It needs to be guaranteed, that all stakeholders have access to the currently valid version of the FD.

*#**Hint:** The FD template has the IP Classification "Proprietary" by default. IP Classification "Confidential" might be required in some cases, e.g. by Ford Functional Safety.*
*#**Macro:** Add Ins -> Edit Document Properties macro (select "Proprietary" for "Document Classification")*

1.3.1 Stakeholder List

For the latest list of stakeholder of the feature and their influence refer to <Put VSEM Link here>.

*#**Hint:** Refer to Ford RE Wiki – Stakeholder List on how to create a stakeholder list. The stakeholder list should be stored in VSEM in the pseudo folder "General Data Artifacts" of the corresponding feature.*

1.4 Document Organization

1.4.1 Document Context

Refer to the Specification Structure page in the Ford RE Wiki to understand how the FD relates to other Ford Requirements Documents and Specifications.

1.4.2 Document Structure

The structure of this document is explained below:

Section 1 – Introduction how to use this document including responsibilities and requisite documents. Explains the terminology. Gives a clarification of the definitions, concepts and abbreviations used in the document.

Section 2 – Feature Description. States briefly the background and the purpose of the feature, feature variants and corresponding regions and markets. Also includes input requirements, assumptions and constraints.

Section 3 – Feature Context describes all external entities, which have an influence on the feature.

Section 4 – Feature Modeling. Contains Use Case, Driving Scenarios, State Charts to describe the functional behavior of the feature.

Section 5 – Safety. Lists System Behaviors and Safety Goals of the feature.

Section 6 – Feature Requirements. Lists functional and non-functional requirements of the feature.

Section 7 – Architecture. Shows the coarse architecture, which the feature requirements are deployed to. Describes the elements and the boundary of the feature as well as the decomposition and distribution of associated functions.

Section 8 – List of Open Conerns

Section 9 – Document Change History including a list of new or modified requirements. The requirements in this document are tagged, and this section contains different types of tables listing all, new, or changed requirements by their title and page no.

Section 10 – Appendix

*#**Hint:** All sections are mandatory, unless explicitly marked by the tag "#Classification" as "optional" or as applicable e.g. to certain domains like "Functional Safety".*

1.5 Document Conventions

1.5.1 Requirements Templates

Each requirement, use case or scenario in this specification shall follow the corresponding template given in the document template *Specification_Macros.dotm* at RE Wiki - Specification Templates.

*#**Hint:** The Specification_Macros.dotm template also provides macros to insert the requirement templates. Refer to "How to use the Specification Templates" on how to enable the macros and the requirements templates in this specification.*
The requirements macro and requirements templates also enable the import of the specification to VSEM (refer to "How to import specifications into VSEM as separate requirements").

1.5.1.1 Identification of requirements

The unique requirement ID given in the headline of any requirement follows the requirement throughout the development process. The requirement ID format follows a well-defined syntax.

All identifiers in a FD shall be composed of 4 parts:

- A leading prefix, which indicates the type of requirement (R=Requirement, UC=Use Case, SC=Scenario, …)
- A prefix, which indicates the abstraction level (F=Feature, FNC=Function, CMP = component).
- Followed by a name, indicating the scope, which the requirement belongs to (e.g. feature or function name)
- Ending with the actual requirement number

Example:
R_F_AutoLamps_00004 This is the fourth requirement on feature level for the feature Autolamps.

1.5.1.2 Requirements Attributes

The templates provided by *Specification_Macros.dotm* define a list of attributes for each requirement. This helps to classify the requirement. The attributes are explained at RE Wiki - Requirements Attributes.

1.6 References

1.6.1 Ford Documents

List here all Ford internal documents, which are directly related to the feature.

Reference	Title	Doc. ID	Document Location	Revision
	24MY U625-611 FuSa_Applicability Power up down liftgate	VDOC086360	VSEM	1
	24MY CDX 746-7 FuSa_ImpactAnalysis Power up down liftgate	VDOC088348	VSEM	1

Table 2: Ford internal Documents

1.6.2 External Documents and Publications

The list of external documents could include books, reports and online sources.

Reference	Document / Publication	Document Location
[bbb]		

Table 3: External documents and publications

1.7 Glossary

*#**Hint**: Terms, concepts and abbreviations used in the document shall be defined and illustrated here. Note that changes to terms and/or concepts described in this section tend to cause major updates to this document.*
The tables below have feature specific definitions and abbreviations. For additional, non-feature specific terms please refer to the RE Glossary

1.7.1 Definitions

Definition	Description

Table 4: Definitions used in this document

1.7.2 Abbreviations

Abbr.	Stands for	Description

Table 5: Abbreviations

1.7.3 Parameters / Values

Name	Description	Range / Resolution

Name	Description	Range / Resolution

Table 6: Parameters / Values used in this document

2 FEATURE OVERVIEW

2.1 Purpose and Description of Feature

The Power Liftgate Feature provides a means to fully open and close a vehicle's liftgate utilizing the vehicle's power from either the interior of the vehicle or from outside the vehicle.
Users are able to request liftgate opening from the following:

- A front interior switch,
- a softkey on front interior touch screen,
- a local exterior switch,
- a remote device such as a Remote Keyless Entry fob or a Phone as a Key enabled Smartphone (via Bluetooth LE),
- a hands-free sensor while a valid passive entry device is in proximity to the rear exterior of the vehicle,
- a valid NFC (Near field communication) device
- a pre-command from Pre-commanded Open on Approach device,
- a request from a remote access feature/subsystem, or

Users are able to request liftgate closing from the following:

- a front interior switch,
- a softkey on front interior touch screen,
- a local interior switch,
- a remote device (keyfob or Phone as a Key device(via Bluetooth LE)),
- a hands-free sensor with a valid passive entry device,
- a valid NFC (Near field communication) device
- a request from a remote access features/subsystems, or

Exterior Switch Operation
To prevent unauthorized opening of the liftgate when the vehicle's lifecycle mode is not Factory, the exterior switch only allows opening from a closed position when the liftgate is unlocked or is temporarily enabled by the user via a remote device (e.g. keyfob). The exterior switch is temporarily enabled when a valid remote device requests a power operation. The exterior switch can also be enabled from a remote entry keyfob on the first press of the keyfob button. The exterior switch will become disabled when the vehicle is locked or when the liftgate is closed. If the exterior switch was enabled via the first press of the liftgate button on a remote entry keyfob and the liftgate did not open, the exterior switch will become disabled after 45 seconds.

Whenever the exterior switch is enabled and the Perimeter Alarm is armed, the Perimeter Alarm will inhibit sounding of the alarm due to the liftgate being ajar or due to Intrusion Sensing or Inclination Sensing.

In the case of a vehicle equipped with Passive Entry, the Exterior switch is also allowed to cause the liftgate to open when a valid Passive Entry device is detected in proximity to the rear exterior of the vehicle (as defined by the Passive Entry feature).
When the vehicle lifecycle mode is Factory, the exterior switch will be allowed to request liftgate operation regardless of the liftgate lock state.

A press of the exterior switch while the liftgate is ajar/open is considered authorized.

Front Interior Switch Operation
The Front Interior Switch is not allowed to open or close the liftgate when the vehicle has been secured from the outside (i.e. doors locked via an exterior source such as a keyfob or keypad or PEPS door handle) with the Ignition off as determined by the Interior Switch Inhibit function within the Locking feature.

In European markets, the interior switch is also not allowed to open or close the liftgate when the ignition is off or accessory and the liftgate is locked.

Softkey on front interior touch screen
The front interior touchscreen is not allowed to open or close the liftgate when the vehicle has been secured from the outside (i.e. doors locked via an exterior source such as a keyfob or keypad or PEPS door handle) with the Ignition off as determined by the Interior Switch Inhibit function within the Locking feature

Requests from the touchscreen are ignored while the LifeCycle Mode of the vehicle is TRANSPORT

Local Interior Switch Operation
To prevent inadvertent activation, the Local Interior Switch is not allowed to open or close the liftgate when the liftgate is latched.

Keyfob Operation
The user can request power liftgate operation from a valid Remote Entry Keyfob by pressing the power liftgate button on the keyfob twice within 3 seconds. Requests from a keyfob are allowed regardless of vehicle lock state. Requests from a keyfob are ignored while the LifeCycle Mode of the vehicle is TRANSPORT.

Phone as a Key Operation
The user can request power liftgate operation from a valid Phone As A Key (PAAK) device. Requests from a Phone as a Key device are allowed regardless of vehicle lock state. Requests from a Phone as a Key device are ignored while the LifeCycle Mode of the vehicle is TRANSPORT.

Hands-Free Operation
The user is able to request power liftgate operation by activating a sensor located under the rear bumper of the vehicle while a valid Passive Entry device is present at the rear exterior of the vehicle. The typical method to activate the hands-free sensor is via a kicking motion under the rear bumper – hence hands-free operation. A valid user device is required to be present at the rear exterior of the vehicle for both power open and power close requests. The hands-free user request is allowed regardless of the vehicle lock state.

The hands-free sensor is ignored if the ignition is on and the vehicle is not stationary (vehicle speed is above 4 kph). The hands-free sensor is also ignored while the LifeCycle Mode of the vehicle is TRANSPORT.

The user is able to disable the hands-free operation via a menu selection in the vehicle's HMI (Message Center or Center stack display).

NFC Operation
The user can request power liftgate operation from a valid NFC device by tapping the device over NFC reader present on the liftgate. Requests from a NFC device are allowed regardless of vehicle lock state. Requests from a NFC device are ignored while the LifeCycle Mode of the vehicle is TRANSPORT.

Determining Direction of Travel on User Request
Each user input has only one selection available to the user – Active or Inactive. There is not a means for the user to specify a desired direction of travel. These are termed "toggle" inputs. When a toggle input is Activated, the power liftgate determines the direction of travel based on the following:

- If the liftgate is already in motion under power, the toggle activation is considered to request the power liftgate to Stop.

- If the liftgate is not already in motion, the toggle activation is interpreted by dividing the path of travel of the liftgate into three regions:
    - Opening Only Region – Area in the path of travel nearest to the fully closed position, inclusive of fully closed. When the liftgate is resting in this region, a toggle input is considered an Open request.
    - Toggle Region – Area in the path of the travel between the Opening Only Region and the Closing Only Region. When the liftgate is resting in this region, a toggle request is considered to be a request to move in the opposite direction from the last movement (prior to stopping). Note that stoppage due to obstacle detection in the opening direction is treated the same. (i.e. The next toggle request after stopping due to an obstacle in the open direction will be a Close operation if the liftgate is in the Toggle Region.)
    - Closing Only Region - Area in the path of travel nearest to the fully open position, inclusive of fully open. When the liftgate is resting in this region, a toggle input is considered a Close request.

Tip to Close Operation

The liftgate will initiate a power close operation when a user starts moving the liftgate in the closing direction manually. To avoid inadvertent activation due to small changes in position of the liftgate, the manual motion must be above a speed threshold (calibrate-able) for a period of time (also calibrate-able).

Requests from Remote Access features/subsystems

There are several cases where a power liftgate operations needs to be requested by other requestors/subsystems/features and not directly by the user.

- Autonomous vehicles will need to ensure the liftgate is closed prior to allowing the vehicle to drive.
- Autonomous vehicles will have Door Access Panel(s) which will allow a valid user to request the liftgate to power open or power close.
- Autonomous vehicles will have Seat display(s)/ Comfort Convenience Display(s) which will allow a valid user to request the liftgate to power open or power close.
- A remote system could request power open or power close to allow temporary access to the vehicle cargo area to accommodate package delivery to the vehicle.
- For commercial vehicles, opening the liftgate automatically to allow delivery drivers access to the cargo area can help improve efficiency.

These will be requests to perform a specific power operation (either Open or Close) rather than a toggle operation.
When an open request occurs, the power liftgate determines the appropriate action based on the following:

- If the liftgate is already at full open or a power open operation is already in progress, the power open request will be ignored. Otherwise a power open operation will occur.

When a close request occurs, the power liftgate determines the appropriate action based on the following:

- If the liftgate is already fully closed, or a power close operation is already in progress, the power close request will be ignored.
- If the liftgate is outside the Open Only Region and a power close operation is not already in progress, then a power close operation will occur.

If the power liftgate is not able to achieve the desired state (either fully open or fully closed) due to vehicle conditions not being correct or due to an obstacle, or due to a fault, the power liftgate will inform the requesting feature that a manual operation is needed.

Verifying Vehicle Conditions

When the vehicle lifecycle mode is not Factory, power operations are allowed to begin only when the vehicle is stationary. The vehicle is determined to be stationary when the vehicle speed is below 4 kph. For vehicles equipped with automatic transmissions, the transmission must be in the Park position as well.
When the vehicle lifecycle mode is Factory, power operations are allowed regardless of Ignition state, Vehicle Speed or Transmission position.

Liftgate Glass Ajar Interlock

For vehicles that are equipped with liftgate glass that can be opened, power open or close operations of the power liftgate are not allowed while the liftgate glass is not closed. If the liftgate glass is opened while a power open or close operation is in progress, the power operation will be stopped. Power release and power cinch are allowed regardless of liftgate glass state.

Power Open Liftgate

When a valid request to open the liftgate occurs and the vehicle conditions are correct, the power liftgate feature will power release the liftgate and then drive the liftgate in the open direction until the full open position is reached or until an obstacle is detected in the path of the liftgate, or until a valid request to Stop occurs. The time from user request to the time the liftgate reaches full open position will be between 4 and 7 seconds under nominal conditions (25 degrees Celsius, battery voltage at 13.5 volts, vehicle on level ground) and no more than 12 seconds under worst case conditions (-30 to 82 degrees Celsius, battery at 9-16 volts, +/- 20% grade vehicle inclination).

Power Close Liftgate

When a valid request to close the liftgate occurs and the vehicle conditions are correct, the power liftgate feature will (is a release included here still?) drive the liftgate in the close direction until the liftgate reaches the secondary latch position and then will power cinch the liftgate to the primary latch position. The time from user request to the time the liftgate reaches full closed and latched position will be between 4 and 7 seconds under nominal conditions (25

degrees Celsius, battery voltage at 13.5 volts, vehicle on level ground) and no more than 12 seconds under worst case conditions (-30 to 82 degrees Celsius, battery at 9-16 volts, +/- 20% grade vehicle inclination).

Power Release Liftgate
A power release of the liftgate latch occurs at the beginning of a power open operation, or when a valid user request occurs while the power liftgate is in manual mode. The power release operation changes the state of the latch so that it is no longer secured to the striker and the liftgate can be opened.

Power Cinch Liftgate
A power cinch of the liftgate latch occurs at the end of a power close operation, or when a user manually closes the liftgate to the secondary latched position in either power mode or manual mode. The power cinch operation changes the state of the latch from the secondary latched position to the primary latched position.

If a user request occurs while a cinch operation is in progress, the power liftgate will wait for the Cinch operation to complete and then respond to the user request.

Manual Liftgate Operation while in Power Mode
To avoid the need to change the power liftgate system into Manual Mode, the liftgate is allowed to be moved manually by the user. This allows the user to place the liftgate in a partially open position.

Obstacle Detection
The power liftgate feature will sense when the liftgate has contacted an obstacle during a power open or power close operation. When an obstacle is detected during a power close operation, it will reverse direction and power open to the full open position. When an obstacle is detected during a power open operation, it will stop the power open operation.

Audible/Visual Indication Feedback
The power liftgate feature provides Audible feedback to the user to indicate when certain events occur:

- An operation chime is sounded when a closing operation is started.
- A warning chime is sounded when:
  - The liftgate is moving and vehicle conditions are no longer met, or
  - An obstacle is detected in the path of the liftgate during movement or when movement is requested.
  - A user requests power movement while the power liftgate is in Manual Mode.
- An urgent warning chime is sounded when a falling liftgate is detected.
- A short chime is sounded on successful programming of the opening height.

The power liftgate feature will request Illuminated Entry feature to activate the interior lights when a user requests to move the liftgate via the remote entry keyfob or Phone as a Key device. Illuminated Entry will honor the request only when the ignition is off.

The power liftgate feature will request the turn indicators to be flashed when a user requests to move the liftgate via the remote entry keyfob or Phone as a Key device.

Manual Mode
The Power Liftgate feature offers the user an option to configure the liftgate to operate as a manual liftgate. This option is selectable in the vehicle's Message Center or Center stack display. When the liftgate is configured to operate as a manual liftgate, the user requests for open will be treated as a request to unlatch the liftgate with no power open operation. User requests to power close the liftgate will be ignored. If the user manually closes the liftgate to the secondary latch position, a power cinch operation will be performed.

Learning Initial Full Open position
When power is first applied to a vehicle, the power liftgate needs to learn the mechanical full open position by performing a power open operation (called a learning cycle). The learning cycle must be initiated from a fully closed position because the latched position is used as a reference for the fully closed endpoint. The mechanical full open position is detected when an obstacle is detected during the learn cycle. To avoid inadvertently learning a full open

position that is lower than the actual full open position, there is a minimum amount of travel needed on the learn cycle before treating an obstacle as the mechanical full open position.

If the power liftgate loses track of its position for any other reason, the learning cycle must be performed again.

Program Liftgate Opening Height
The user is able to adjust the position at which the liftgate completes the open operation (the full open position). To adjust the opening height, the user moves the liftgate either manually or by power operation (followed by a stop request), and then presses and holds the local interior switch. Any power open operations will then be complete when the liftgate reaches the adjusted position. The position of the liftgate must be above a minimum programmable height to allow the user to adjust the opening height.

Control Falling Liftgate
At the end of any power operation that does not result in the liftgate being closed, the power liftgate will monitor the position of the liftgate for a short duration to detect that the liftgate is not holding its position. If the liftgate is detected to be falling, a power close operation is initiated to control the speed of the liftgate closing.

If an obstacle is detected during the close operation, the liftgate will be held in place for a short duration. At the end of that duration, the power liftgate will again monitor the position of the liftgate to detect that the liftgate is not holding its position. If the liftgate is detected to be falling again, a power close operation is again initiated.

If a user request for power operation occurs, the liftgate will be held in place for a short duration and the power close operation will resume.

Slam Protection
The power liftgate feature will monitor the liftgate position for manual movement whenever the liftgate is not fully closed and no power operation is active in either manual mode or power mode. If movement is detected above a certain speed threshold, the power liftgate will activate slam protection and limit the speed of the liftgate movement. Any user request for a power open or close will be ignored while slam protection is active.

Interaction with Passive Smart Unlock
On vehicles equipped with Passive Entry, a search for valid passive entry devices will be initiated by the Smart Unlock feature when a power close operation is initiated while the vehicle is locked. If a valid device is found inside the rear area of the vehicle, but no valid device is found on the exterior rear area of the vehicle, Smart Unlock will request the power liftgate to stop the power close operation and sound two horn chirps to alert the user.

Valet Mode
When the Valet Mode feature is active, the power liftgate feature will ignore all user requests to power release, power open, power close. Power cinching is allowed regardless of the Valet Mode state.

Operating Voltage Range
The power liftgate feature will operate at battery voltages between 9 and 16 volts, except that a power operation will only be allowed to be initiated at battery voltages between 10.5 and 16 volts. Once a power operation is in progress, it will continue unless the battery voltage goes outside the 9 to 16 volt range. If a user request for a power operation occurs while the battery voltage is between 9 and 10.5, the request will cause a liftgate latch release, if not already released, but no power operation will occur.

Engine Stop/Start Interaction
On vehicles equipped with engine stop/start capability, the powertrain system may crank the engine without the ignition changing to Start. That engine crank can cause the battery voltage to drop momentarily. To avoid inadvertently interrupting a power liftgate operation due to the voltage drop, the power liftgate will allow power operation to occur while the battery voltage is lower than the 9 volt minimum operating voltage while the engine is cranking due to the stop/start capability.

Configurations
TBD

2.2 Feature Variants

*#**Hint:** Definitions for different variants of the feature (if applicable). Give each variant a descriptive name by which it can be referenced further on in the document. If no variant exists, state "No Feature Variants".*
The Variant Description should give a short informative text which describes the variants of the feature.

Variant Name	Variant Description	Remarks

Table 7: Feature Variants

2.2.1 Regions & Markets

*#**Hint:** Description of purpose and functionality of the feature. If there is no variant, give feature name in first column.*

Market / Region / Variant Name	North America	South America	Europe	Middle East / Africa	Asia / Pacific	China
	X	X	X	X	X	

Table 8: Regions & Markets

2.3 Input Requirements

2.3.1 Legal Requirements

Per FMVSS 206 Section 2.4.3, the front interior switch is not allowed to open the liftgate unless the vehicle is in Park as this is considered as functionally equivalent to a separate action to unlock the door. See FEDE item ID USA-006718.

Otherwise, the rear door must be unlocked to allow the front interior switch to open the power liftgate.

2.3.2 Trustmark Requirements

2.3.3 Industry Standards

2.4 Lessons Learned

No liftgate handle to close liftgate manually. Global 8D 216256
Hard to Close – efforts too high. Global 8D 215923, 214619, 234983
Bounce Back – False Reversal QSF 01020150045

2.5 Assumptions

- Assume that the liftgate will be counterbalanced such that it will retain position without any assistance from power liftgate for both power and manual modes.
- Assume RKE, NFC and PaaK features will confirm user authorization prior to requesting power liftgate operation.
- Assume that Remote Access features/subsystems will only request open/unlatch after confirming authorization to access the vehicle. That means the power liftgate feature will not confirm user authorization for these requests, much like RKE and PaaK requests.

- Assume liftgate position sensing uses a relative position sensor. That means the power liftgate needs to learn the endpoints of travel.
- Obstacle detection is contact-based. That means the power liftgate cannot detect the obstacle until the obstacle makes contact with the liftgate and/or the liftgate opening.

3 FEATURE CONTEXT

3.1 Feature Context Diagram

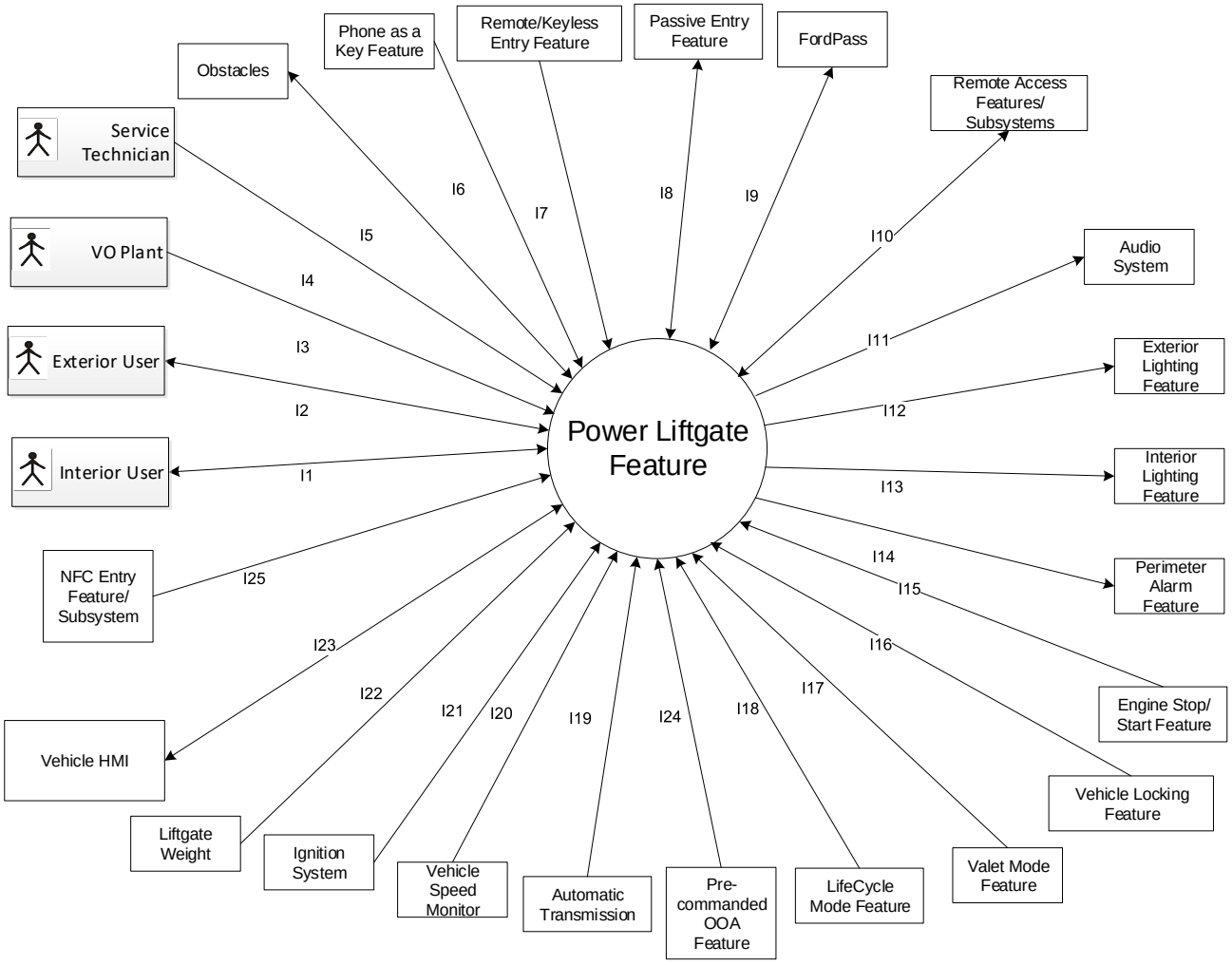

Figure 1: Power Liftgate Context Diagram

3.2 List of Influences

ID	External Entity	Influence Description
I1	Interior User	*Request power operation of the liftgate from inside the vehicle.*
		Change Menu Setting to select Power Mode or Manual Mode.
		Receive chime feedback from power liftgate.
I2	Exterior User	Request power operation of the liftgate from outside the vehicle.
		Receive chime and light flash feedback from power liftgate.
I3	Service Technician	Is able to update the feature or switch it off/on.
I4	VO Plant	Is able to customize the feature or switch it off/on.
I5	Obstacles	Objects that are in the path of travel of the liftgate that could obstruct the liftgate from completing a power operation.
I6	Phone as a Key Feature	Request power liftgate operation via Phone App.
I7	Remote/Keyless Entry	Request power liftgate operation via Remote Entry keyfob.
I8	Passive Entry	Determine whether a valid passive entry device is in the area of the rear of the vehicle, when requested.
I9	FordPass	Request power operation of the liftgate from a Cellular device
I10	Remote Access Features/Subsystems	Request power liftgate operation remotely.
I11	Audio System	The audio system plays chimes for soft- and hard warnings upon power close request.
I12	Exterior Lighting Feature	Flash the turn indicators when requested.
I13	Interior Lighting Feature	Activate Illuminated Entry when power liftgate opens.
I14	Perimeter Alarm	Inhibit Alarm activation due to liftgate opening while alarm is armed.
I15	Engine Stop/Start Feature	Inform power liftgate when an engine crank is in progress.
I16	Vehicle Locking Feature	Inform power liftgate when the liftgate is locked and when the exterior switch is allowed to cause a power liftgate operation.
		Smart Unlock can request a power close operation to stop.
I17	Valet Mode Feature	Inform power liftgate when Valet Mode is active.
I18	Life Cycle Mode Feature	Inform power liftgate of the vehicle's lifecycle mode (Normal, Transport, Factory).
I19	Automatic Transmission	Informs power liftgate whether the transmission is in Park or not. Note: For manual Transmission, only vehicle speed is used to determine that the vehicle is stationary.
I20	Vehicle Speed Monitor	Informs power liftgate of the speed that the vehicle is traveling.
I21	Ignition System	Informs power liftgate of the state of the vehicle's ignition.
I22	Liftgate Weight	Provides resistive load to power liftgate system.
I23	Vehicle HMI	Request power liftgate operation, manual mode configuration via front message center or center stack display
I24	Pre-commanded OOA Feature	Request power liftgate open via pre-command device
I25	NFC Entry Feature/Subsystem	Request power liftgate operation via valid NFC device

Table 9: List of Influences

4 FEATURE MODELING

4.1 Operation Modes and States

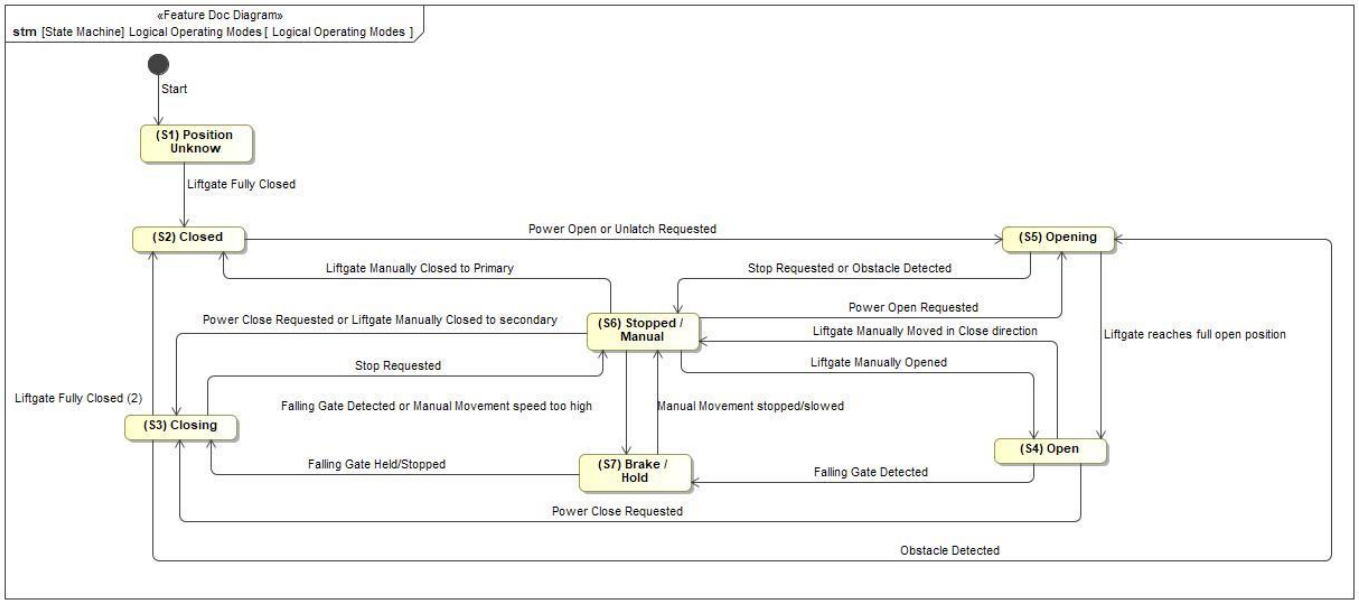

Figure 2: Feature Operation Modes and States

State	Description	Requirements Reference (optional)
S1	Position Unknown – Wait until the liftgate is fully closed before allowing power operation.	
S2	Closed – Liftgate is fully closed. Only unlatch and open operations are allowed.	
S3	Closing – Liftgate is power closing or cinching.	
S4	Open – Liftgate is fully open. Only close operation allowed.	
S5	Opening – Liftgate is power opening or unlatching	
S6	Stopped/Manual – Liftgate is unpowered, but not fully open or closed. Gate can be manually moved. Power open or close operations are allowed.	
S7	Brake/Hold – Falling gate is detected (immediately following an open operation) or manual movement is too fast. Liftgate is being held in position by power liftgate.	

Table 10: Operation Modes and States

Transition ID	Description	Requirements Reference (optional)
T1	Start – Begin logic here. No power operation is performed.	
T2	Position Unknown to Closed – The liftgate is determined to be fully closed to the primary latch position. No power operation is performed.	
T3	Closed to Opening – A valid user request to power open is received. A power Unlatch followed by a power Open operation will be performed.	
T4	Closing to Closed – Liftgate reaches the fully closed to primary latch position. Power Cinch and power Close operations will be stopped.	

T5	Closing to Opening – An obstacle is detected in the path of the liftgate while closing. Power Cinch and power Close operations will be stopped. Power Unlatch and power Open operation will be performed.	
T6	Closing to Stopped/Manual – A valid user request to Stop is received. Power Close and power Cinch operation will be stopped. Liftgate expected to maintain position without power.	
T7	Open to Closing – A valid user request to power Close is received. Power Close operation will be performed. Once liftgate reaches the secondary latch position, a power Cinch will be performed.	
T8	Open to Brake/Hold – A falling gate is detected. Power will be applied to hold the liftgate in place.	
T9	Open to Stopped/Manual – Liftgate is manually moved away from the full open position. No power operation will be performed.	
T10	Opening to Open – Liftgate reaches the full open position during a power open operation. Power Open operation will be stopped. Liftgate is expected to maintain position without power.	
T11	Opening to Stopped/Manual – A valid user request to Stop is received or an obstacle is detected in the path of the liftgate in the open direction. Power Open operation will be stopped.	
T12	Stopped/Manual to Closed – Liftgate is manually closed to the primary latched position. No power operation will be performed.	
T13	Stopped/Manual to Closing – A valid user request to Close is received. A power Close operation will be performed.	
T13a	Stopped/Manual to Closing – Liftgate is manually closed to the secondary latched position. A power Cinch operation will be performed.	
T14	Stopped/Manual to Open – Liftgate is manually moved to the full open position.	
T15	Stopped/Manual to Opening – A valid user request to open is received. A power Open operation will be performed.	
T16	Stopped/Manual to Brake/Hold – Liftgate is manually moved to high speed. Power will be applied to slow the liftgate speed.	
T17	Brake/Hold to Closing – After a falling gate has been held in place, a power close operation will be performed.	
T18	Brake/Hold to Stopped/Manual – Manual liftgate speed is slowed. Power for slowing the liftgate is removed.	

Table 11: Transitions between Operational Modes and States

4.2 Use Cases

4.2.1 Use Case Diagram

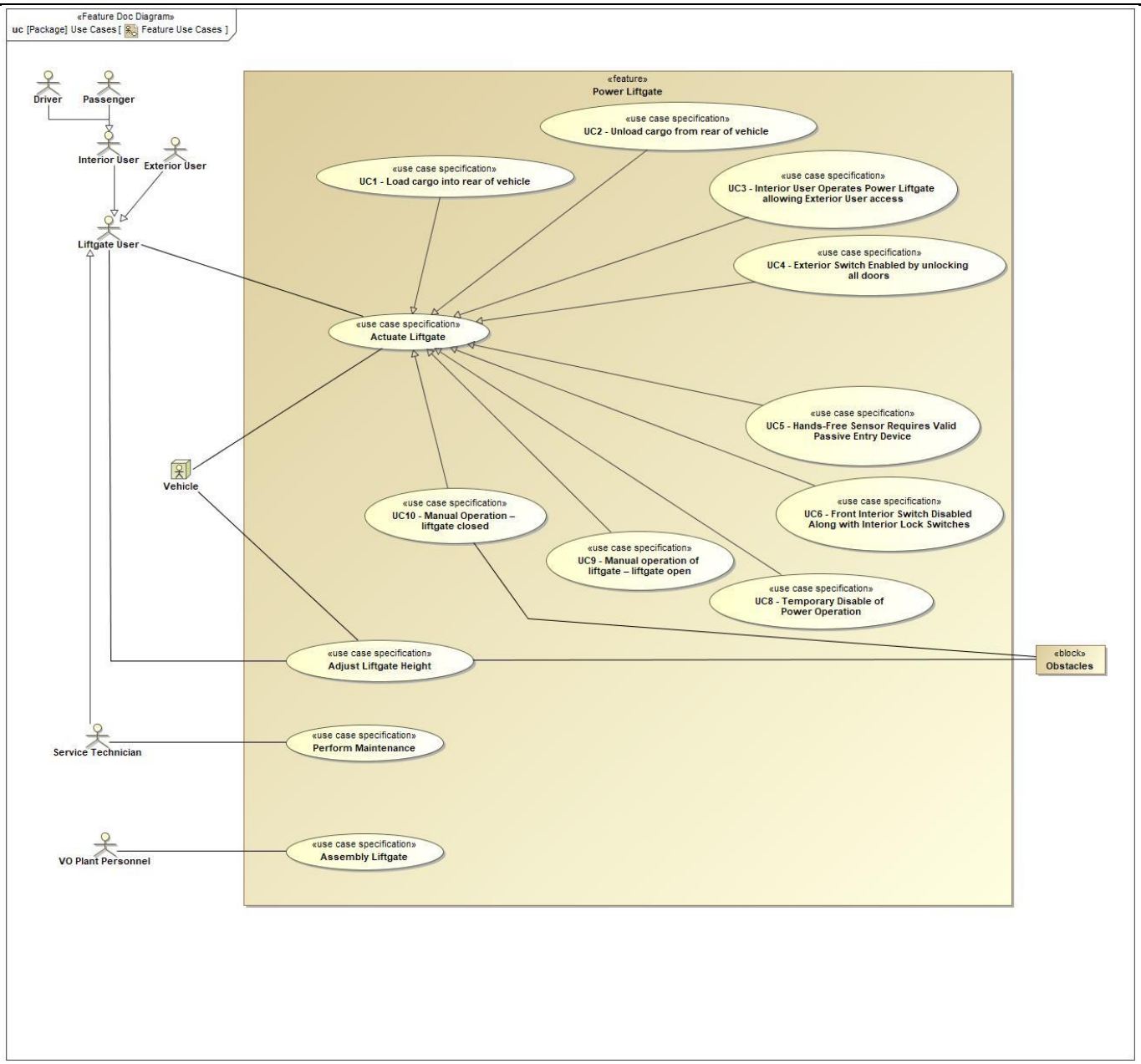

Figure 3: Use Case Diagram

4.2.2 Actors

Actor	Description
Vehicle	Vehicle that contains a power liftgate system.
Power Liftgate	System in a vehicle that applies power to the vehicle's liftgate to open or close the liftgate.
Exterior User	Person that is on the outside of the vehicle that interacts with the power liftgate.
Interior User	Person that is on the inside of the vehicle that interacts with the power liftgate.
Obstacle	Object that is obstructing the path of the liftgate such that it interferes with the ability of the liftgate to open or close.
Service Technician	Person that interacts with the power liftgate to perform maintenance or repair.
VO Plant Personnel	Person(s) within the Vehicle Operations assembly plant that interact with the power liftgate.

Table 12: List of Actors

4.2.3 Use Case Descriptions

###UC_F_PLG_00001### Load cargo into rear of vehicle-exterior user

Purpose		Load cargo into rear of vehicle
Actors		Exterior User Power Liftgate Vehicle
Precondition		Vehicle is stationary Vehicle is locked Liftgate is closed
Main Flow	M1	Exterior User approaches rear of vehicle carrying cargo.
	M2	Exterior User activates power liftgate to open via keyfob
	M2.5	Power Liftgate verifies vehicle is stationary.
	M3	Power Liftgate Unlatches and Opens the liftgate.
	M4	Exterior User loads cargo into rear of vehicle.
	M5	Exterior User activates power liftgate to close via local interior switch.
	M5.5	Power Liftgate verifies vehicle is stationary.
	M6	Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 1		• Exterior User approaches rear of vehicle carrying cargo. • Exterior User activates power liftgate to open via keyfob

		• Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User loads cargo into rear of vehicle. • Exterior User activates power liftgate to close via keyfob. • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 2		• Exterior User approaches rear of vehicle carrying cargo. • Exterior User activates power liftgate to open via keyfob. • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User loads cargo into rear of vehicle. • Exterior User activates power liftgate to close via Phone as a Key. • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 3		At M2, the Exterior User does not have access to keyfob (keyfob in pocket, purse, etc). • Exterior User activates Power Liftgate to open via Hands-Free Sensor • Power Liftgate verifies presence of keyfob-via Passive Entry search • Proceed as in M2.5.
Alternative Flow 4		• Exterior User approaches rear of vehicle carrying cargo. • At M2, the Exterior User does not have access to keyfob (keyfob in pocket, purse, etc). Exterior User activates Power Liftgate to open via Hands-Free Sensor • Power Liftgate verifies presence of a valid phone device via Passive Entry search • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User loads cargo into rear of vehicle. • Exterior User activates power liftgate to close via Phone as a Key. • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 5		At M2, the Exterior User activates power liftgate to open via Phone as a Key device. • Proceed as in M2.5.
Alternative Flow 6		• Exterior User approaches rear of vehicle carrying cargo. • At M2, the Exterior User activates power liftgate to open via Phone as a Key device. • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User loads cargo into rear of vehicle. • Exterior User activates power liftgate to close via Phone as a Key. • Power Liftgate verifies vehicle is stationary. Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 7		• Exterior User approaches rear of vehicle carrying cargo. • At M2, the Exterior User activates power liftgate to open via Phone as a Key device. • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User loads cargo into rear of vehicle. • Exterior User activates power liftgate to close via Hands-free sensor. • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.

Alternative Flow 8		• Exterior User approaches rear of vehicle carrying cargo. • At M2, the Exterior User activates power liftgate to open via Phone as a Key device. • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User loads cargo into rear of vehicle. • Exterior User activates power liftgate to close via keyfob. • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 9		• Exterior User pre-commands liftgate to open on next approach • Exterior User approaches rear of vehicle carrying cargo with a valid passive entry device. • Pre commanded OOA verifies presence of Passive Entry device via Passive Entry search • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User loads cargo into rear of vehicle. • Exterior User activates power liftgate to close via local interior switch.. • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 10		At M2, the Exterior User does not have access to keyfob (keyfob in pocket, purse, etc). • Exterior User activates Power Liftgate to open via tapping a valid NFC device on the liftgate NFC reader • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User loads cargo into rear of vehicle. • Exterior User activates power liftgate to close via tapping a valid NFC device on the liftgate NFC reader. • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 11		• Exterior User approaches rear of vehicle carrying cargo • At M2, the Exterior User activates power liftgate to open via a remote access subsystem/feature • Power Liftgate verifies vehicle is stationary • Power Liftgate Unlatches and Opens the liftgate • Exterior User loads cargo into rear of vehicle • Exterior User activates power liftgate to close via a remote access subsystem/feature • Power Liftgate verifies vehicle is stationary Power Liftgate closes the liftgate and cinches the latch to primary latched position
Post-condition		Exterior User has successfully loaded cargo into rear of vehicle. Liftgate is closed. Vehicle remains locked.

###UC_F_PLG_00002### Unload cargo from rear of vehicle-exterior user

Purpose		
Actors		Exterior User Power Liftgate Vehicle
Precondition		Vehicle is stationary

		Vehicle is unlocked Liftgate is closed
Main Flow	M1	Exterior User approaches rear of vehicle.
	M2	Exterior User activates power liftgate to open via Exterior Switch
	M2.1	Power Liftgate verifies vehicle unlocked condition.
	M2.5	Power Liftgate verifies vehicle is stationary.
	M3	Power Liftgate Unlatches and Opens the liftgate.
	M4	Exterior User unloads cargo from rear of vehicle.
	M5	Exterior User activates power liftgate to close via keyfob.
	M5.5	Power Liftgate verifies vehicle is stationary.
	M6	Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 1		At M5, the Exterior User does not have access to keyfob (keyfob in pocket, purse, etc). • Exterior User activates Power Liftgate to close via Hands-Free Sensor • Power Liftgate verifies presence of keyfob via Passive Entry search • Proceed as in M5.5
Alternative Flow 2		At M5, the Exterior User activates power liftgate to close via Phone as a Key device. • Proceed as in M5.5.
Alternative Flow 3		At M5, the Exterior User activates power liftgate to close via local interior switch. Proceed as in M5.5.
Alternative Flow 4		• Exterior User pre-commands liftgate to open on next approach • Exterior User approaches rear of vehicle with a valid passive entry device. • Pre commanded OOA verifies presence of Passive Entry device via Passive Entry search • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User unloads cargo from rear of vehicle. • Exterior User activates power liftgate to close via local interior switch • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 5		• At M2, the Exterior User activates power liftgate to open via tapping a valid NFC device on the liftgate NFC reader • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User unloads cargo from rear of vehicle • Exterior User activates power liftgate to close via tapping a valid NFC device on the liftgate NFC reader • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 6		At M5, the Exterior User activates power liftgate to close via a remote access subsystem/feature • Proceed as in M5.5.
Post-condition		Exterior User has successfully unloaded cargo from rear of vehicle. Liftgate is closed. Vehicle remains unlocked.

###UC_F_PLG_00003### Interior User Operates Power Liftgate allowing Exterior User access

Purpose		Captures events where the owner is inside the vehicle and wants to provide temporary access to others. Examples include: - Picking up children from school, sporting events, etc. - Curbside grocery/retail pickup.
Actors		Interior User Exterior User Power Liftgate
Precondition		Vehicle is stationary Vehicle is unlocked Liftgate is closed
Main Flow	M1	Exterior User approaches rear of vehicle.
	M2	Interior User activates power liftgate to open via Front Interior Switch.
	M2.5	Power Liftgate verifies that Trim Switch Inhibit is not active.
	M2.5	Power Liftgate verifies vehicle is stationary.
	M3	Power Liftgate Unlatches and Opens the liftgate.
	M4	Exterior User accesses cargo area at rear of vehicle.
	M5	Interior User activates power liftgate to close via Front Interior Switch.
	M5.5	Power Liftgate verifies vehicle is stationary.
	M6	Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Alternative Flow 1		• At M2, Interior User activates power liftgate to open via Front Interior touch screen. (SYNC or similar) • Power Liftgate verifies that Trim Switch Inhibit is not active. • Power Liftgate verifies vehicle is stationary. • Power Liftgate Unlatches and Opens the liftgate. • Exterior User accesses cargo area at rear of vehicle. • Interior User activates power liftgate to close via Front Interior touch screen. (SYNC or similar) • Power Liftgate verifies vehicle is stationary. • Power Liftgate closes the liftgate and cinches the latch to primary latched position.
Post-condition		Liftgate is closed. Vehicle remains unlocked.

###UC_F_PLG_00004### Exterior Switch Enabled by unlocking all doors

Purpose		
Actors		Exterior User Power Liftgate
Precondition		Vehicle is stationary Vehicle is locked No valid passive entry device present Perimeter Alarm Armed Liftgate is closed
Main Flow	M1	Exterior User activates exterior switch.
	M1.5	Power Liftgate verifies vehicle locked condition.
	M2	Power Liftgate does NOT power open or release latch.
	M3	Exterior User Unlocks all doors using valid keyfob.
	M4	Exterior User activates exterior switch.
	M4.5	Power Liftgate verifies vehicle is stationary.
	M5	Power Liftgate Unlatches and Opens the liftgate.
Alternative Flow 1		At M3, Exterior User single presses the Power Liftgate button on a valid keyfob.

		• Proceed as in Step M4.
Alternative Flow 2		At M3, a valid passive entry device is brought to the rear exterior of the vehicle. • Proceed as in Step M4.
Post-condition		Liftgate is fully open. Perimeter Alarm does not sound.

###UC_F_PLG_00005### Hands-Free Sensor Requires Valid Passive Entry Device

Purpose		
Actors		Exterior User Power Liftgate
Precondition		Vehicle is stationary Vehicle is locked No valid passive entry device present Perimeter Alarm Armed Liftgate is closed
Main Flow	M1	Exterior User activates Hands-Free Sensor
	M2	Power Liftgate does NOT power open or release latch.
	M3	Exterior User Unlocks all doors using valid keyfob.
	M4	Exterior User activates Hands-Free Sensor
	M4.5	Power Liftgate verifies valid passive entry device not present at rear exterior of vehicle.
	M5	Power Liftgate does NOT power open or release latch.
	M6	A valid passive entry device is brought to the rear exterior of the vehicle.
	M7	Exterior User activates Hands-Free Sensor
	M7.5	Power Liftgate verifies valid passive entry device present at rear exterior of vehicle.
	M7.5	Power Liftgate verifies vehicle is stationary.
	M8	Power Liftgate Unlatches and Opens the liftgate.
Post-condition		Liftgate is fully open. Perimeter Alarm does not sound.

###UC_F_PLG_00011### Pre-commanded OOA Requires Valid Passive Entry Device

Purpose		
Actors		Exterior User Power Liftgate
Precondition		Vehicle is stationary Vehicle is locked No valid passive entry device present Perimeter Alarm Armed Liftgate is closed Exterior user has pre-commanded liftgate to open on next approach
Main Flow	M1	Exterior User approaches rear of the vehicle
	M2	Power Liftgate does NOT power open or release latch.
	M3	A valid passive entry device is brought to the rear exterior of the vehicle.
	M4	Pre commanded OOA verifies valid passive entry device present at rear exterior of vehicle.
	M5	Power Liftgate verifies vehicle is stationary.
	M6	Power Liftgate Unlatches and Opens the liftgate.
Post-condition		Liftgate is fully open. Perimeter Alarm does not sound.

###UC_F_PLG_00006### Front Interior Switch Disabled Along with Interior Lock Switches

Purpose		
Actors		Exterior User Interior User Power Liftgate
Precondition		Vehicle is stationary Vehicle is locked Ignition Off Perimeter Alarm Armed Liftgate is closed
Main Flow	M1	Interior User activates Front Interior Switch.
	M1.5	Power Liftgate verifies that Trim Switch Inhibit is active.
	M2	Power Liftgate does NOT power open or release latch.
	M3	Exterior User Unlocks all doors using valid keyfob.
	M4	Interior User activates Front Interior Switch.
	M4.5	Power Liftgate verifies that Trim Switch Inhibit is not active.
	M4.5	Power Liftgate verifies vehicle is stationary.
	M5	Power Liftgate Unlatches and Opens the liftgate.
Alternative Flow 1	A1	Interior User activates Front Interior touchscreen soft key.
	A1.5	Power Liftgate verifies that Trim Switch Inhibit is active.
	A2	Power Liftgate does NOT power open or release latch.
	A3	Exterior User Unlocks all doors using valid keyfob.
	A4	Interior User activates Front Interior touchscreen.
	A4.5	Power Liftgate verifies that Trim Switch Inhibit is not active.
	A4.5	Power Liftgate verifies vehicle is stationary.
	A5	Power Liftgate Unlatches and Opens the liftgate.
Post-condition		Liftgate is fully open. Perimeter Alarm does not sound.

###UC_F_PLG_00007### Liftgate Opening Height Adjustment

Purpose		Users who park their vehicle in a personal garage where the full open height of the garage door may be less than the full open height of the liftgate may repeatedly encounter a situation where the power liftgate contacts the garage door before the power open cycle completes.
Actors		Exterior User Obstacle (Garage Door)
Precondition		Vehicle is stationary Vehicle is positioned such that the liftgate will contact a garage door before fully opening. Vehicle is unlocked Liftgate is closed
Main Flow	M1	Exterior User activates the exterior switch.
	M1.1	Power Liftgate verifies vehicle unlocked condition.
	M1.5	Power Liftgate verifies vehicle is stationary.
	M2	Power Liftgate Unlatches and moves the liftgate in the open direction.
	M3	Before the liftgate makes contact with the garage door, the Exterior User activates the Local Interior Switch.
	M4	Power Liftgate stops.
	M5	The Exterior User manually adjusts the height of the liftgate.

	M6	The Exterior User presses and holds the local interior switch.
	M7	Power Liftgate stores the current position of the liftgate as the user-requested opening position. Power Liftgate sounds a chime to indicate to the Exterior User that the position has been stored. Power Liftgate does NOT cause any movement to the liftgate.
	M8	The Exterior User activates the local interior switch.
	M8.5	Power Liftgate verifies vehicle is stationary.
	M9	Power Liftgate closes and latches the liftgate.
	M10	The Exterior User activates the exterior switch.
	M10.1	Power Liftgate verifies vehicle unlocked condition.
	M10.5	Power Liftgate verifies vehicle is stationary.
	M11	Power Liftgate unlatches and opens liftgate to the new user-requested position.
Post-condition		Liftgate is open to the new user-requested height. Liftgate does not make contact with garage door.

###UC_F_PLG_00008### Temporary Disable of Power Operation

Purpose		Users may want to temporarily disable power operation of the liftgate to avoid inadvertent actuation while the rear of the vehicle is open. One example scenario is the "tailgating" scenario where the liftgate is left open purposely to allow any of multiple people to access the rear of the vehicle, or even to allow the rear of the vehicle to be used as seating at an outdoor event.
Actors		Interior User Exterior Users Power Liftgate
Precondition		Vehicle is stationary Liftgate is open
Main Flow	M1	Interior User turns the vehicle's ignition to Run.
	M2	Interior User accesses message center menu or center stack menu, and selects Liftgate to be in Manual mode.
	M3	Exterior User inadvertently presses the local interior switch.
	M4	The power liftgate does NOT power close.
Alternative Flow 1		At M3, a user activates any of the open/close devices. • The power liftgate does NOT power close.
Alternative Flow 2		At M3, a user pulls the liftgate in the close direction (as if to initiate Tip to Close). • The power liftgate does NOT power close.
Post-condition		The liftgate remains open.

###UC_F_PLG_00009### Manual operation of liftgate – liftgate open

Purpose		Users may want to operate the liftgate manually in some scenarios where a complete closing or opening may not be desired. Example includes a case where cargo may not allow full closure of the gate.
Actors		Interior User Exterior User Power Liftgate
Precondition		Vehicle is stationary Liftgate is open Cargo obstructs closing path of the liftgate.
Main Flow	M1	Interior User turns the vehicle's ignition to Run.

	M2	Interior User accesses message center menu or center stack menu, and selects Liftgate to be in Manual mode.
	M3	Exterior User manually moves the liftgate to the desired position.
	M4	The power liftgate does NOT power close.
Post-condition		Liftgate is positioned per the manual direction of the user.

###UC_F_PLG_00010### Manual Operation – liftgate closed

Purpose		Users may want to operate the liftgate manually in some scenarios where a complete closing or opening may not be desired. Example includes a case where a device such as a bike rack may be affixed to the vehicle in a way that obstructs the path of the liftgate.
Actors		Interior User Exterior User Power Liftgate
Precondition		Vehicle is stationary Vehicle is Unlocked Liftgate is Closed Obstacle placed in opening path of liftgate.
Main Flow	M1	Interior User turns the vehicle's ignition to Run.
	M2	Interior User accesses message center menu or center stack menu, and selects Liftgate to be in Manual mode.
	M3	Exterior User presses exterior handle switch.
	M3.5	Power Liftgate verifies vehicle is stationary.
	M4	Power liftgate releases liftgate latch, but does not power open.
	M5	Exterior User manually moves the liftgate to the desired position.
Post-condition		Liftgate is positioned per the manual direction of the user.

4.3 Driving and Operation Scenarios

###SC_F_PLG_00002### No power liftgate operation while vehicle is being driven

Short Description	Power liftgate will not initiate a power open operation while the vehicle is being driven. The vehicle is considered as being driven when the vehicle speed is above 4 kph or, for automatic transmission vehicles, if the transmission is not in the Park position.
Condition	Liftgate is closed Transmission in gear and vehicle is in motion.
Reference	

Flow of Actions	
1	Interior User activates Front Interior Switch.
2	Power Liftgate does NOT unlatch or power open the liftgate. Power Liftgate sounds chime to indicate operation is not allowed.
2a	Interior User activates Front Interior touch screen softkey.
2b	Power Liftgate does NOT unlatch or power open the liftgate. Power Liftgate sounds chime to indicate operation is not allowed.
3	Exterior User activates power operation request via remote entry keyfob.
4	Power Liftgate does NOT unlatch or power open the liftgate. Power Liftgate sounds chime to indicate operation is not allowed.
5	Exterior User activates power operation request via Phone as a Key device.

6	Power Liftgate does NOT unlatch or power open the liftgate. Power Liftgate sounds chime to indicate operation is not allowed.

###SC_F_PLG_00001### User starts driving while power liftgate closing

Short Description	Power liftgate will continue to attempt to close the liftgate if the vehicle starts being driven before the close operation completes. Obstacle detection may get triggered due to perturbations in the liftgate movement caused by the vehicle movement.
Condition	Liftgate is Open Vehicle is stationary and transmission is in Park. Ignition is Run Engine is On
Reference	

Flow of Actions	
1	Interior User activates Front Interior switch or Front Interior touch screen softkey.
2	Power Liftgate begins closing liftgate.
3	Interior User shifts transmission to Drive and releases brake.
4	Vehicle starts to move.
5	Power Liftgate continues to close the liftgate. Power Liftgate sounds chime to warn Interior User that liftgate has not finished closing.
6	If Power Liftgate finishes closing without triggering Obstacle Detection, the chime will stop sounding.
6a	If Obstacle detection is triggered, Power Liftgate will reverse the liftgate and power to the open position. The chime will continue sounding until the vehicle is stopped and the transmission placed in Park.

###SC_F_PLG_00003### Obstacle in path of liftgate - Closing

Short Description	While closing, if the liftgate encounters an obstacle, the power liftgate will cease the closing operation and immediately perform a power open operation. Opening the liftgate will prevent any entrapment of the obstacle. Opening to the full open position makes it more obvious to users that the power close operation did not complete.
Condition	Vehicle is Stationary Liftgate is Open
Reference	

Flow of Actions	
1	User activates a power close operation.
2	Power liftgate begins closing liftgate.
3	Power liftgate detects an obstacle in the path of the liftgate.
4	Power liftgate reverses liftgate motion to power open.
5	Power liftgate continues to open until the full open position is reached.

###SC_F_PLG_00004### Obstacle in path of liftgate - Opening

Short Description	While Opening, if the liftgate encounters an obstacle, power liftgate will cease the power open operation. A power close operation is not initiated to prevent cycling in the case of an obstacle in both directions of travel.
Condition	Vehicle is Stationary

	Liftgate is Closed
Reference	

Flow of Actions	
1	User Activates a power open operation.
2	Power liftgate begins power open operation.
3	Power liftgate detects an obstacle in the path of the liftgate.
4	Power liftgate Stops the power open operation.

###SC_F_PLG_00005### Extra Load on Gate while opening

Short Description	Power liftgate has the capability to power open a liftgate even though additional weight has been added to the liftgate (such as snow/ice buildup or an aftermarket bike rack attached to the liftgate). Once the power open operation has finished, the struts may not be able to hold the liftgate in the final position and the liftgate may fall back in the close direction. The power liftgate will stop the liftgate from falling momentarily to allow users time to react and move away from the path of the liftgate (if necessary). The power liftgate will then perform a power close operation to bring the liftgate back to the closed position.
Condition	Vehicle is Stationary Liftgate is Closed
Reference	

Flow of Actions	
1	User Activates a power open operation.
2	Power liftgate unlatches and powers open the liftgate.
3	The liftgate begins to fall back in the close direction.
4	The power liftgate activates to stop the liftgate movement.
5	The power liftgate then performs a power close operation.

5 FEATURE REQUIREMENTS

5.1 Functional Requirements

###R_F_PLG_00001### Required User Request Sources

The Power Liftgate shall provide users with the following sources to request power liftgate operation:

- Device that is on or near the liftgate and is accessible from the exterior while the liftgate is closed (Exterior Switch).
- Device that is on or near the liftgate and is accessible from the exterior while the liftgate is open and not accessible from the exterior while the liftgate is closed (Local Interior Switch).
- Device that is accessible to a user in the driver seat of the vehicle (Front Interior Switch or softkey on front interior touchscreen – SYNC/similar or both).
- Dedicated button on a Remote Entry keyfob.

End of Requirement

###R_F_PLG_00002### Allowed Optional User Request Sources

The power liftgate shall provide users with the following sources to request power liftgate operation as applicable:

- A dedicated soft button on the user's phone when the Phone as a Key feature is present on a vehicle.
- Activation of a hands-free sensor while a valid Passive Entry device is present at the rear exterior of the vehicle. (Optional per program)
- An NFC card reader
- Manual movement of the liftgate in the close direction from a stationary position (aka Tip to Close).
- Requests from remote access features/subsystems when those features/subsystems are present on a vehicle.
    - Remote access features/subsystems include:
        - Door Access Panel
        - Seat display(s)/Comfort Convenience display(s)
        - Cloud
        - TvF Journey Manager

End of Requirement

###R_F_PLG_00028### Enable Operation From Exterior Switch Device

The power liftgate shall enable the Exterior Switch Device to request power liftgate open or unlatch operations when:

- On vehicles equipped with Perimeter Alarm,
    - The vehicle's doors are all unlocked via the interior Unlock Switch while the Perimeter Alarm is not Armed or Activated, or
    - The vehicle's doors are all unlocked by any other electrical means, regardless of Perimeter Alarm state.
- On vehicles not equipped with Perimeter Alarm,
    - The vehicle's doors are all unlocked by any electrical means.
- On all vehicles,
    - A power liftgate operation is requested via a remote entry device (RKE keyfob or Phone as a Key Device) or,
    - A power liftgate operation is requested via Pre-commanded Open on Approach device, or
    - A valid request is received from a Remote Access features/subsystems to Unlock the liftgate, or
    - A valid request is received from a valid NFC device to Unlock the liftgate, or
    - A valid request is received from a remote entry device to unlock the liftgate (optional).

Note : For EU, A first press of liftgate release button on the valid Remote Entry device will enable the exterior switch for 45 sec
For NA, A first press of liftgate release button on the valid Remote Entry device will do nothing

End of Requirement

###R_F_PLG_00003### Toggle Operation From Exterior Switch

The power liftgate shall initiate a Toggle operation when a user momentarily activates the Exterior Switch device and the following are true:

- All general power operation preconditions are met,
- AND
- A valid passive entry device is present at the rear exterior of the vehicle, or
- The liftgate is not closed, or
- The liftgate exterior switch is enabled for power open or power unlatch operation.

End of Requirement

###R_F_PLG_00004### Toggle Operation From Local Interior Switch

The power liftgate shall initiate a Toggle operation when a user momentarily activates the Local Interior Switch device and the following are true:

- All general power operation preconditions are met, and
- The liftgate is not closed, and
- User Selected Open Height is not being programmed.

End of Requirement

###R_F_PLG_00005### Toggle Operation From Front Interior Switch

The power liftgate shall initiate a Toggle operation when a user momentarily activates the Front Interior Switch device and the following are true:

- All general power operation preconditions are met, and
    - The liftgate is not closed,
    - OR
        - On vehicles that follow ECE regulations,
            - The Trim Switch Inhibit feature has not inhibited interior unlock switch operation, and
            - The vehicle is unlocked.
        - On other vehicles,
            - The Trim Switch Inhibit feature has not inhibited interior unlock switch operation.

End of Requirement

###R_F_PLG_00066### Toggle Operation From Front Interior touchscreen

The power liftgate shall initiate a Toggle operation when a user momentarily activates the softkey on Front Interior touchscreen device (SYNC or similar) and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal and
    - The liftgate is not closed,
    - OR
        - On vehicles that follow ECE regulations,
            - The Trim Switch Inhibit feature has not inhibited interior unlock switch operation, and
            - The vehicle is unlocked.
        - On other vehicles,
            - The Trim Switch Inhibit feature has not inhibited interior unlock switch operation.

End of Requirement

###R_F_PLG_00006### Toggle Operation From Remote Entry Device

The power liftgate shall initiate a Toggle operation when a user performs a double press of the Power Liftgate button on a valid Remote Entry device (per RQT-190200-015565) and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.

End of Requirement

###R_F_PLG_00007### Toggle Operation From Phone as a Key Device

The power liftgate shall initiate a Toggle operation when a user activates a Power Liftgate request via a Phone as a Key device (per RQT-000670-701728, PaaK-REQ-234415) and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.

End of Requirement

###R_F_PLG_00008### Toggle Operation From Hands-Free Sensor

The power liftgate shall initiate a Toggle operation when a user activates the Liftgate Hands-Free Sensor device and the following are true:

- All general power operation preconditions are met, and
- A valid passive entry device is present at the rear exterior of the vehicle, and
- The vehicle LifeCycle Mode is Normal.

End of Requirement

###R_F_PLG_00072### Toggle Operation From NFC Device

The power liftgate shall initiate a Toggle operation when a user activates a Power Liftgate request via a valid NFC device and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.

End of Requirement

###R_F_PLG_00071### Open Operation from a Pre-commanded OOA

The power liftgate shall initiate a power open operation when a request to power open is received from a Pre-commanded Open on Approach device and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.
- AND
    - The liftgate is not performing a power open or power close operation, and
    - The liftgate position is in the Open Only region.

End of Requirement

###R_F_PLG_00009### Toggle Request While Power Movement in Progress

The power liftgate shall initiate a Stop operation when a Toggle operation is initiated while the power liftgate is performing a power open or power close operation.

End of Requirement

###R_F_PLG_00010### Defining Toggle Regions

The path of travel of the liftgate shall be divided into three regions:
- Open Only Region – The region from Fully Closed to a point in travel where a power close operation can be successfully completed.
- Close Only Region – The region from Fully Open to a point in travel where a power open operation may be needed.
- Toggle Region – The region between the Open Only region and the Close Only region.

End of Requirement

###R_F_PLG_00011### Toggle Operation while Stationary in the Open Only Region

The power liftgate shall initiate a power open operation when:
- A Toggle operation is initiated, and
- The liftgate is not performing a power open or power close operation, and
- The liftgate position is in the Open Only region.

End of Requirement

###R_F_PLG_00012### Toggle Operation while Stationary in the Close Only Region

The power liftgate shall initiate a power close operation when:
- A Toggle operation is initiated, and
- The liftgate is not performing a power open or power close operation, and
- The liftgate position is in the Close Only region.

End of Requirement

###R_F_PLG_00013### Toggle Operation while Stationary in the Toggle Region - Close

The power liftgate shall initiate a power close operation when:
- A Toggle operation is initiated, and
- The liftgate is not performing a power open or power close operation, and
- The liftgate position is in the Toggle region, and
- The last powered movement was in the open direction.

Note: If the last powered movement was in the open direction and that movement was stopped due to an obstacle in the Toggle region, that is treated the same as a Stop operation.

Note: If the last powered movement was an open operation and was stopped outside the Toggle region and the liftgate is subsequently moved manually into the Toggle region, this requirement applies.

End of Requirement

###R_F_PLG_00014### Toggle Operation while Stationary in the Toggle Region - Open

The power liftgate shall initiate a power open operation when:

- A Toggle operation is initiated, and
- The liftgate is not performing a power open or power close operation, and
- The liftgate position is in the Toggle region, and
- The last powered movement was in the close direction.

Note: If the last powered movement was a close operation and was stopped outside the Toggle region and the liftgate is subsequently moved manually into the Toggle region, this requirement applies.

End of Requirement

~~###R_F_PLG_00015### Close Operation From Tip to Close Activation~~

~~The power liftgate shall initiate a power close operation when:~~

- ~~The Tip to Close feature is enabled for the vehicle, and~~
- ~~The liftgate is not performing a power open or power close operation, and~~
- ~~The liftgate position is in the Close Only region or the Toggle region, and~~
- ~~The liftgate is manually moved in a way that indicates the user intends the liftgate to be power closed, and~~
- ~~All general power operation preconditions are met.~~

~~End of Requirement~~

###R_F_PLG_00016### Open Operation from a Seat display/Comfort Convenience display Feature/Subsystem

The power liftgate shall initiate a power open operation when a request to power open is received from a Seat display/Comfort Convenience display feature/subsystem and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.
- AND
    - The liftgate is performing a power close operation,
    - OR
    - The liftgate is not performing a power open or power close operation, and the liftgate position is in the Open Only region or the Toggle region.

End of Requirement

###R_F_PLG_00017### Close Operation From a Seat display/Comfort Convenience display Feature/Subsystem

The power liftgate shall initiate a power close operation when a request to power close is received from a Seat display/Comfort Convenience display feature/subsystem and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.
- AND
    - The liftgate is performing a power open operation,
    - OR
    - The liftgate is not performing a power open or power close operation, and the liftgate position is in the Close Only region or the Toggle region.

End of Requirement

###R_F_PLG_00025### Open Operation From a Door Access Panel

The power liftgate shall initiate a power open operation when a request to power open is received from a Door Access Panel (DAP) and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.
- AND
    - The liftgate is performing a power close operation,
    - OR
    - The liftgate is not performing a power open or power close operation, and the liftgate position is in the Open Only region or the Toggle region.

End of Requirement

###R_F_PLG_00026### Close Operation From a Door Access Panel

The power liftgate shall initiate a power close operation when a request to power close is received from a Door Access Panel (DAP) and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.
- AND
    - The liftgate is performing a power open operation,
    - OR
    - The liftgate is not performing a power open or power close operation, and the liftgate position is in the Close Only region or the Toggle region.

End of Requirement

###R_F_PLG_00074### Close Operation From a TvF Journey Manager Feature/Subsystem

The power liftgate shall initiate a power close operation when a request to power close is received from the TvF Journey Manager feature/subsystem and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.
- AND
    - The liftgate is performing a power open operation,
    - OR
    - The liftgate is not performing a power open or power close operation, and the liftgate position is in the Close Only region or the Toggle region.

End of Requirement

###R_F_PLG_00075### Open Operation From a Cloud feature/subsystem

The power liftgate shall initiate a power open operation when a request to power open is received from a cloud feature/subsystem and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.
- AND
    - The liftgate is performing a power close operation,
    - OR
    - The liftgate is not performing a power open or power close operation, and the liftgate position is in the Open Only region or the Toggle region.

End of Requirement

###R_F_PLG_00076### Close Operation From a Cloud feature/subsystem

The power liftgate shall initiate a power close operation when a request to power close is received from a cloud feature/subsystem and the following are true:

- All general power operation preconditions are met, and
- The vehicle LifeCycle Mode is Normal.
- AND
  - The liftgate is performing a power open operation,
  - OR
  - The liftgate is not performing a power open or power close operation, and the liftgate position is in the Close Only region or the Toggle region.

End of Requirement

###R_F_PLG_00030### General Power Operation Preconditions

The general power operation preconditions shall be met when all the following are true:

- The vehicle speed is less than 4 kilometers per hour (kph), and
- For vehicle with an automatic transmission, the transmission is in the Park position, and
- No obstacle is detected in the path of the liftgate, and
- The vehicle's battery is within the power liftgate normal operating range, and
- For vehicle's with moveable liftgate glass, the liftgate glass is closed, and
- The user selected power liftgate mode is Power, and
- The Valet Mode feature is not active, and
- The vehicle LifeCycle Mode is not Factory.

Note: Reference RQT-011421-015387System Lockout.

End of Requirement

###R_F_PLG_00019### Power Open Operation

When a power open operation is initiated, the power liftgate shall perform a power release operation and then drive the liftgate in the open direction. When either the User Selected Open Position or the full open position is reached or a Stop operation or a Close operation is initiated, the power liftgate shall stop driving the liftgate in the open direction and the power open operation is ended.

End of Requirement

###R_F_PLG_00020### Power Close Operation

When a power close operation is initiated, the power liftgate shall drive the liftgate in the close direction until either the secondary latched position is reached or a Stop operation or an Open operation is initiated. When the secondary latched position is reached, the power liftgate shall perform a power cinch operation. When a Stop operation is initiated, the power liftgate shall stop driving the liftgate in the close direction, and the power close operation is ended.

End of Requirement

###R_F_PLG_00021### Power Release Operation

When a power release operation is initiated, the power liftgate shall drive the latch release mechanism to allow the latch to open.

End of Requirement

###R_F_PLG_00022### Power Cinch Operation

When a power cinch operation is initiated, the power liftgate shall drive the latch cinch mechanism to close the latch from the secondary position to the primary position. The power liftgate shall stop driving the latch to the primary position when a stop operation is initiated or a power release operation is initiated or when the primary latched position is reached.

End of Requirement

###R_F_PLG_00023### Manual Mode Operation – No Power Operation

When the user selected power liftgate mode is Manual, power liftgate shall not perform any power open or power close operation.

End of Requirement

###R_F_PLG_00024### Manual Mode Operation - Power Release

The power liftgate shall initiate a power release operation when a user momentarily activates the Exterior Switch device and the following are true:

- The user selected power liftgate mode is Manual, and
- The Valet Mode feature is not active,
- AND
    - A valid passive entry device is present at the rear exterior of the vehicle, or
    - The liftgate exterior switch is enabled for power open or power unlatch operation.

End of Requirement

###R_F_PLG_00029### Power Cinch Due to Manual Close

The power liftgate shall initiate a power cinch operation when the liftgate is manually moved in the close direction to the secondary latched position, regardless of the user selected power liftgate mode (power or manual).

End of Requirement

###R_F_PLG_00031### User Programmed Open Height

The power liftgate shall store the liftgate position as the User Selected Open Height when the Local Interior Switch device is pressed and held for 3 seconds.

End of Requirement

###R_F_PLG_00032### Stop Operation due to Smart Unlock

The power liftgate shall initiate a Stop operation when the Smart Unlock feature requests Stop and a power close operation is being performed.

End of Requirement

5.1.1 Error Handling

###R_F_PLG_00033### Liftgate Glass Ajar Interlock

On vehicle with moveable liftgate glass, the power liftgate shall initiate a Stop operation when the liftgate glass becomes ajar/open and a power open or close operation is being performed.

Note: The general vehicle preconditions check prohibits power operation from being initiated when the liftgate glass is already ajar/open.

End of Requirement

###R_F_PLG_00034### Obstacle Detection - Closing Behavior

The power liftgate shall initiate a power open operation when:
- An obstacle is encountered while performing a power close operation, and
- The close operation was not initiated due to a falling liftgate, and
- For vehicles with automatic transmission, the transmission is in Park.

End of Requirement

###R_F_PLG_00048### Obstacle Detection - Closing Behavior While Vehicle Moving

The power liftgate shall initiate a Stop operation when:
- An obstacle is encountered while performing a power close operation, and
- The close operation was not initiated due to a falling liftgate, and
- For vehicles with automatic transmission, the transmission is NOT in Park.

Note: Reference RQT-011421-015387System Lockout.

End of Requirement

###R_F_PLG_00035### Obstacle Detection - Opening Behavior

The power liftgate shall initiate a Stop operation when an obstacle is encountered while performing a power open operation.

End of Requirement

###R_F_PLG_00036### Hold Operation due to a Falling Liftgate

The power liftgate shall initiate a Hold operation when the liftgate is determined to be falling after a power operation is completed.

End of Requirement

###R_F_PLG_00037### Hold Operation

The power liftgate shall actively apply power to hold the liftgate in a steady position for 2 seconds whenever a Hold operation is initiated.

End of Requirement

###R_F_PLG_00038### Power Close After Hold due to Falling Liftgate

The power liftgate shall initiate a power close operation directly after a Hold operation due to a falling liftgate is ended.

End of Requirement

###R_F_PLG_00039### Obstacle Detection during Power Close Due to Falling Liftgate

The power liftgate shall initiate a Hold operation when an obstacle is encountered during a power close operation and the power close operation was initiated due to a falling liftgate.

End of Requirement

###R_F_PLG_00040### User Request during Close Due to Falling Liftgate

The power liftgate shall initiate a Hold operation when a request for power operation (Open, Close, Stop, Release) occurs. The request for power operation will be ignored.

End of Requirement

###R_F_PLG_00041### Slam Protection

The power liftgate shall monitor liftgate manual movement speed and apply power to limit the speed of manual liftgate movement.

End of Requirement

###R_F_PLG_00042### User Request During Slam Protection

The power liftgate shall ignore any request for power operation (Open, Close, Stop, Release) except for power operations due to a falling liftgate.

End of Requirement

###R_F_PLG_00047### Vehicle Movement After Initiating Power Operation

The power liftgate shall initiate a Stop operation when:

- A power open operation is being performed.
- AND
  - Vehicle Speed is greater than 4 kph, or
  - For vehicles with automatic transmission, the transmission is not in Park.

Note: Reference RQT-011421-015387System Lockout.

End of Requirement

5.2 Non-Functional Requirements

###R_F_PLG_00067### Power Liftgate Chime loudness and sound quality

The power liftgate operation, feedback and warning chimes shall follow loudness and sound quality parameters as specified by RQT- 001500-001077 - Operational Sound Quality

End of Requirement

###R_F_PLG_00043### Power Liftgate Power Open/Close Cycle Time

The power liftgate shall control power open and power close operation speed as specified by RQT-011421-015375 Rear Power Closure Cycle Time.

Note: The referenced requirement also has a subjective smoothness of operation statement.

End of Requirement

###R_F_PLG_00044### Power Liftgate Cinch Cycle Time

The power liftgate shall perform power cinch operations within times specified by RQT-011405-008961-Latch Cinching Time – Power Liftgate.

End of Requirement

###R_F_PLG_00045### Power Liftgate Obstacle Detection Performance

The power liftgate shall detect obstacles within the constraints specified by RQT-011421-015386 Power Closure Obstacle Detection and Worst Case Loading.

End of Requirement

###R_F_PLG_00046### Falling Gate Detection

The power liftgate shall detect a falling gate per RQT-011421-015372 PLG Operation in the presence of a Hold Open Error State.

End of Requirement

###R_F_PLG_00049### Response Time to User Request

The power liftgate shall begin a power operation (Open, Close, Release, Cinch) or stop a power operation in progress within 300 milliseconds of the request being activated.

Note: Reference RQT-011421-015383 Toggled Reversal Time.

End of Requirement

###R_F_PLG_00050### Operating Voltage Range

The power liftgate shall operate within the voltage range specified by RQT-191001-009906 Low/High Voltage Guaranteed Function/Performance.

Note: There is also a maximum voltage drop from the battery to the ECU, per RQT-191001-009992 Generic Module Wiring Voltage Drop.

End of Requirement

###R_F_PLG_00051### Operation During Voltage Drop Due to Engine Stop/Start Event

On vehicles with Engine Stop/Start, the power liftgate shall allow a power operation in progress to continue when the vehicle battery voltage drops below the normal operating range due to an engine start event that is initiated by the Engine Stop/Start feature.

End of Requirement

5.2.1 Safety

5.2.2 Security

5.2.3 Reliability

5.3 HMI Requirements

###R_F_PLG_00052### Menu Selection For Power Liftgate Mode - message center

The Message Center shall provide a menu item to allow a user to select the power liftgate mode, including manual mode and power mode.

End of Requirement

###R_F_PLG_00068### Menu Selection For Power Liftgate Mode-center stack

The Center stack display shall provide a menu item to allow a user to select the power liftgate mode, including manual mode and power mode.

End of Requirement

###R_F_PLG_00069### Softkey selection For Power Liftgate operation

The front interior touchscreen shall provide a menu item/softkey to allow a user to operate the power liftgate.

End of Requirement

###R_F_PLG_00053### User Selection of Power Liftgate Mode

When a user has selected a new power liftgate mode via the menu item, the Message Center or center stack display shall request that the power liftgate update the power liftgate mode to the user selected mode.

End of Requirement

###R_F_PLG_00054### Power Liftgate Mode Storage

The power liftgate shall store the power liftgate mode selected by a user via the Message Center menu or center stack display item and provide feedback to the Message Center/center stack display on the current mode selected.

End of Requirement

###R_F_PLG_00055### User Feedback - Exterior Lights

The power liftgate shall request the turn indicator lights be flashed once when:

- A request is received from a user for a Toggle, Open or Close Operation from one of the following sources:
  - A valid Remote Entry Device
  - A valid Phone as a Key Device
  - FordPass
  - The Exterior Switch Device a valid Passive Entry device is present at the rear exterior of the vehicle.
  - The Hands-Free Sensor while a valid Passive Entry device is present at the rear exterior of the vehicle.
  - An NFC device
  - A Door Access Panel
  - A Seat display/ Customer Convenience display
  - TVF Journey Manager
  - A cloud feature/subsystem
- OR
- A request is received to Enable the Exterior Switch Device from one of the following sources:
  - A valid Remote Entry Device
  - FordPass

End of Requirement

###R_F_PLG_00056### User Feedback - Illuminated Entry

The power liftgate shall request the Illuminated Entry feature to be activated when:

- A request is received from a user for a Toggle, Open or Close Operation from one of the following sources:
  - A valid Remote Entry Device
  - A valid Phone as a Key Device
  - FordPass
  - The Exterior Switch Device a valid Passive Entry device is present at the rear exterior of the vehicle.
  - The Hands-Free Sensor while a valid Passive Entry device is present at the rear exterior of the vehicle.
  - An NFC device
  - A Door Access Panel
  - A Seat display/ Customer Convenience display
  - TVF Journey Manager
  - A cloud feature/subsystem

Note: The Illuminated Entry feature has other preconditions to allow activation of the interior lights/position lights (e.g. Ignition state is Off). The power liftgate request will only result in lights activation when those preconditions are met.

End of Requirement

###R_F_PLG_00057### Operation Chime Due to Power Close

The power liftgate shall request an Operation Chime when a power close operation is initiated.

End of Requirement

###R_F_PLG_00058### Feedback Chime Due to User Height Programming

The power liftgate shall request a Feedback Chime when a User Selected Open Height is stored.

End of Requirement

###R_F_PLG_00059### Warning Chime Due to Falling Liftgate

The power liftgate shall request a Warning Chime when a Falling Gate is detected. The Warning Chime shall continue until the liftgate reaches the fully closed position, or the gate is no longer falling.

End of Requirement

###R_F_PLG_00060### Warning Chime due to Obstacle

The power liftgate shall request a Warning Chime when an obstacle is detected during a power open or power close operation, or an obstacle is detected when a power open or power close operation is initiated.

End of Requirement

###R_F_PLG_00061### Warning Chime When User Request is Inhibited

The power liftgate shall request a Warning Chime when the user requests a power open or power close operation and the power operation cannot be performed due to:

- The user selected power liftgate mode is Manual Mode, or
- The battery voltage is outside the normal operating range, or
- The vehicle speed is greater than 4 kilometers per hour (kph), or
- For vehicle with an automatic transmission, the transmission is not in the Park position, or
- The liftgate position is not known, or
- The power liftgate is not able to perform the power operation.

End of Requirement

###R_F_PLG_00073### Operation Chime Due to Power Open

The power liftgate shall request an Operation Chime when a power open operation is initiated.

End of Requirement

###R_F_PLG_00070### Front interior touchscreen softkey contact size and spacing

Front interior touchscreen softkey contact size and spacing shall follow design rule specified by requirement RQT-002003-021843.

End of Requirement

5.4 Other Requirements

5.4.1 Design Requirements

###R_F_PLG_00062### No Power Operation When Liftgate Position is Not Known

The power liftgate shall not allow power operation when the liftgate position is not known.

End of Requirement

###R_F_PLG_00063### Allow Power Open Operation From Fully Closed Position

The power liftgate shall allow a power open operation upon user request when the liftgate is fully closed and all other conditions for power open are met to allow learning of the full open position.

End of Requirement

###R_F_PLG_00064### Learning Full Open Position

When a power open operation is active and the full open position has not yet been determined, the power liftgate shall continue the power open operation and monitor liftgate position relative to the fully closed position until the mechanical full open position has been reached. Once the mechanical full open has been reached, the power liftgate shall store the liftgate position as the full open position.

End of Requirement

5.4.2 Manufacturing Requirements

###R_F_PLG_00065### Power Operation in Factory Mode

The power liftgate shall initiate a Toggle operation when the vehicle LifeCycle Mode is Factory and:

- A user momentarily activates the Exterior Switch device, or
- A user momentarily activates the Local Interior Switch device, or
- A user momentarily activates the Front Interior Switch device, or
- A user momentarily activates the Front Interior touchscreen softkey, or
- A user performs a double press of the Power Liftgate button on a valid Remote Entry device (per RQT-190200-015565), or
- A user activates a Power Liftgate request via a Phone as a Key device (per RQT-000670-701728, PaaK-REQ-234415), or
- A user activates the Liftgate Hands-Free Sensor device and a valid passive entry device is present at the rear exterior of the vehicle.

Note: In Factory mode, there is no check of preconditions.

End of Requirement

5.4.3 Service Requirements

*#**Hint:** Requirements in this section could specify, e.g. what needs to be considered, if individual ECUs are replaced or new SW is flashed to ECUs (parameter set in non-volatile memory might get inconsistent and needs also to be updated).*

TBD

5.4.4 After Sales Requirements

*#**Hint:** Requirements in this section could specify, e.g. input for the Owner's Manual could be gathered.*

TBD

5.4.5 Process requirements

N/A

6 FUNCTIONAL SAFETY

*#**Classification**: Functional Safety only*
*#**Hint:** This section is dedicated to the Ford Functional Safety (ISO26262) process. For details of this process refer*
*#**Link:** Ford Functional Safety Sharepoint*
*#**Contact:** RE Wiki Roles & Responsibilites page – Role: Application Functional Safety Engineer*

6.1 System Behaviors for HARA

*#**Classification**: Functional Safety only*
*#**Hint:** List of selected system behaviors is an input to the Hazard Analysis and Risk Assessment (HARA). There needs to be a rationale why other system behaviors / functions are not considered.*

ID	Name
	Close Liftgate
	Open Liftgate

Table 13: System Behaviors for HARA

6.2 Safety Assumptions

*#**Hint:** Copy the assumptions from the document "FFSD 02 Hazard Analysis and Risk Assessment", Tab. "2 - Assumptions" with "Ref/ID", "Name", "Category", "Description", "Purpose". In this document, additionally a reference to the requirement ID is inserted.*
*#**Link:** Functional Safety Sharepoint – HARA*

ID	Assumption	
1	**Name**	No User Verification
	Description	User requesting control of the feature may not have the ability to view the liftgate and potential obstructions in the liftgate path. Controllability ratings assume worst case that user requesting movement of the liftgate feature did not verify liftgate movement path is free from obstructions.
	Purpose	
	Category	<UNSPECIFIED>
	Related Requirements IDs	
2	**Name**	Safe vehicle motion condition
	Description	User attempts to perform the open / close request when the vehicle is not in motion.
	Purpose	
	Category	<UNSPECIFIED>
	Related Requirements IDs	

Table 14: Functional Safety Assumptions

6.3 Safety Goals

*#**Classification**: Functional Safety only*
*#**Hint:** The list of Functional Safety Goals is an output of the Hazard Analysis and Risk Assessment (HARA) and therefore not required during the initial creation of the Feature Document.*
*#**Link:** Functional Safety Sharepoint – HARA*

ID	Goal			
1	**Goal Name**	Avoid unintended liftgate closure		
	Description	The system shall avoid entanglement due to unintended closure of the liftgate		
	Safety Goal Concept			
	ASIL	A	**FTTI**	
	Related FSR IDs			
2	**Goal Name**	Prevent Unintended Opening of Tailgate at Speed		
	Description	The system shall avoid opening the tailgate while the vehicle is moving at speed.		
	Safety Goal Concept	Safety Goal Concept: Warning & Recovery Concept:		
	ASIL	A	**FTTI**	
	Related FSR IDs			

Table 15: Functional Safety Goals

6.4 Functional Safety Requirements

*#**Classification**: Functional Safety only*
*#**Hint:** The section lists the Functional Safety Requirements (FSRs) derived from a Safety Goal and Assumptions. The following should be noted for the use of the attribute fields for FSRs*
- The "Source Req" trace link field in each FSR should have a reference to
- a safety goal in ch. 6.3 "Safety Goals" or
- an assumption in ch. 6.2 "Safety Assumptions"

*#**Link:** Functional Safety Sharepoint – Functional Safety Concept*
RE Wiki - Requirements Attributes

6.4.1 <Goal 1 Name>

Name: Avoid unintended liftgate closure
Purpose:
Text: The system shall avoid entanglement due to unintended closure of the liftgate
ASIL: A

6.4.2 <Goal 2 Name>

Name: Prevent Unintended Opening of Tailgate at Speed
Purpose:
Text: The system shall avoid opening the tailgate while the vehicle is moving at speed.
ASIL: A

6.4.3 Derivation of Requirements on Assumptions

*#**Classification**: Functional Safety only*
*#**Hint:** Derive requirements from the Assumptions (refer to section "Safety Assumptions"*

6.5 (Decomposed) Functional Safety Requirements

*#**Classification:** Functional Safety Only*
*#**Hint:** For ASIL D features additional measures like a requirements decomposition might be required. Fill out the following table for each ASIL D decomposition applied in the feature. The decomposition rationale is the reason why*

the decomposition was performed, whereas the rationale for each requirement expresses the reason and thought behind that particular requirement and should include how the requirement is able to independently fulfill the needs of the parent requirement.
***#Link:** Functional Safety Sharepoint - Functional Safety Concept*

Initial Safety Requirement	Functional Safety Requirement X	
Decomposition Rationale		
Method for Decomposition	Choose a Method	
Functional Safety Requirement 1 after Decomposition	**F-S-Req-ID**	
	F-S-Req. Title	
	ASIL	
	Rationale	
	Allocated to	
Functional Safety Requirement 2 after Decomposition	**F-S-Req-ID**	
	F-S-Req. Title	
	ASIL	
	Rationale	
	Allocated to	
Functional Safety Requirement for Independence *Note: should consider commonly used input, output and processing* *Note: additional row should be added if additional requirements for Independence are necessary*	**F-S-Req.-ID**	
	F-S-Req. Title	
	ASIL	
	Rationale	

Table 16: Requirements Decomposition Table

7 ARCHITECTURE

7.1 Functional Architecture

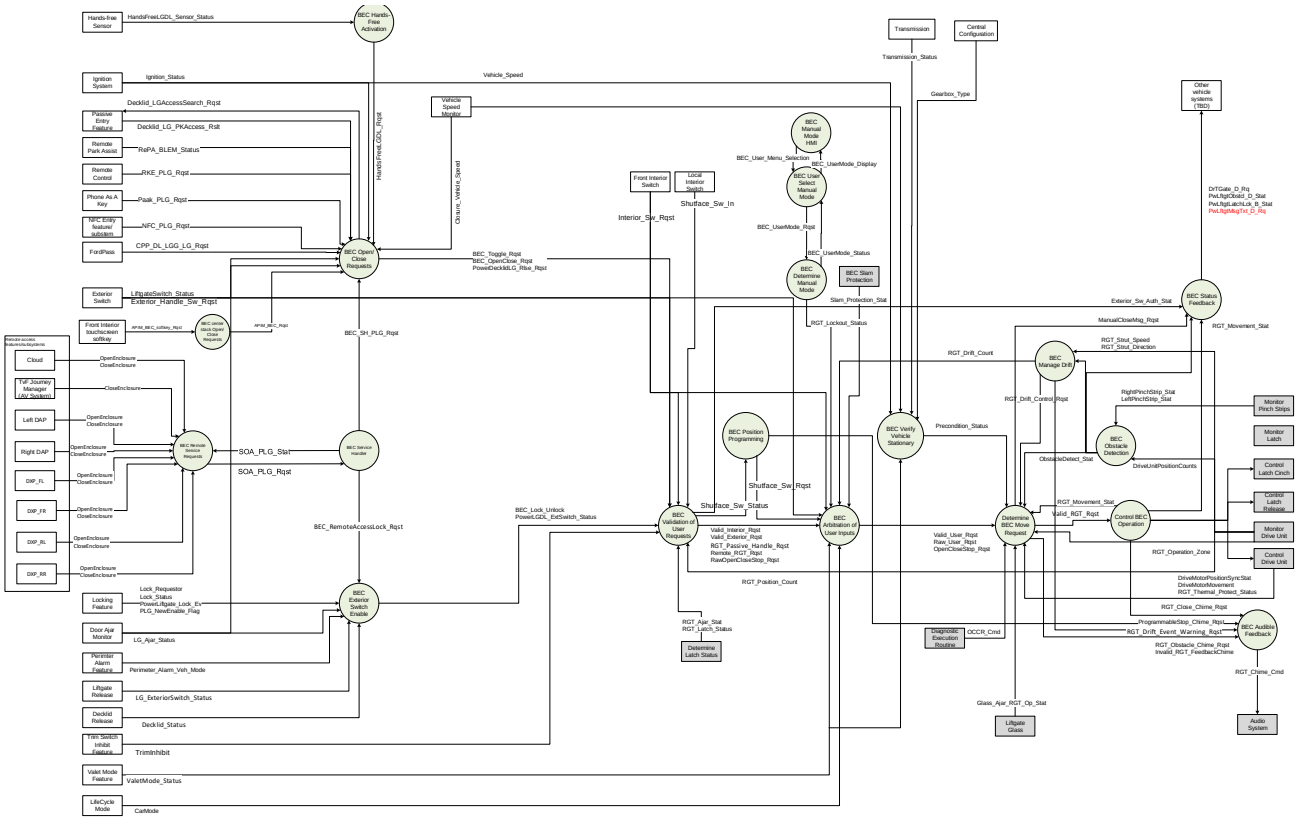

Figure 4: Functional Boundary Diagram

7.1.1 List of Functions

Function Name	Description	Comments
BEC Open/Close Requests	Accepts requests from exterior users and consolidates them into a single request to be validated. For Exterior Switch and Hands-Free activation, the function will interact with the Passive Entry feature to determine whether a valid passive entry device is present outside the rear of the vehicle.	
BEC center stack Open/Close Requests	Accepts requests from interior users via interior touchscreen softkey.	
BEC Service Handler	Accepts lock or unlock requests and open or close requests from features that are external to the Back End Closure feature. Some examples are requests from an Autonomous Vehicle, or from a Cloud-based feature, seat display or a Door Access Panel.	
BEC Remote Service Requests	Accepts and arbitrates lock or unlock requests and open or close requests from features/subsystems that are external to the Back End Closure feature. Some examples are requests from an Autonomous Vehicle, or from a Cloud-based feature, seat display or a Door Access Panel.	
BEC Exterior Switch Enable	Determines whether the Exterior Switch is allowed to request a power operation of a Back End Closure.	

Function Name	Description	Comments
BEC Hands-Free Activation	Determines when a user has actuated the hands-free to request a power open or close operation.	
BEC Validation of User Requests	Verifies that the specific conditions that apply to an individual switch (such as lock state, trim switch inhibit, etc) are correct to allow a requested operation.	
Arbitration of User Inputs	Decides which action to take when there are multiple potentially conflicting user inputs that are requesting to operate the Back End Closure. The function also takes into consideration the vehicle conditions (vehicle speed, transmission position, liftgate ajar, valet mode, manual mode etc.) before allowing an action to be requested.	
BEC Position Programming	Provides the user a means to set the full open position of the power liftgate to a height determined by the user.	
Verify BEC Operation Preconditions	Verifies the vehicle level preconditions (vehicle speed, transmission position, etc) are correct to allow power operation of the liftgate.	
Determine BEC Move Request	Assesses any move requests, either from a user or from diagnostics or the Manage Drift function, to decide what action the back end closure should take. The function also takes into consideration the vehicle preconditions and obstacle detection states while determining the desired action.	
Control BEC Operation	Coordinates the power open or power close operation when a valid request occurs. Power open sequence is to power release the latch and then actuate the drive unit. Power close sequence is to actuate the drive unit until reaching the secondary latched position, then power cinch the latch to the primary latched position.	
Power Open	Controls the power liftgate drive unit(s) to apply force to the liftgate in the opening direction. Liftgate speed is monitored to control the amount of force applied so that liftgate opening speed is controlled.	
Power Close	Controls the power liftgate drive unit(s) to apply force to the liftgate in the closing direction. Liftgate speed is monitored to control the amount of force applied so that liftgate opening speed is controlled.	
Power Release	Controls the latch to actuate the latch release mechanism.	
Power Cinch	Controls the latch to actuate the latch cinch mechanism.	
BEC Audible Feedback	Coordinates requests for audible feedback to the customer for various events such as initiation of a power close operation, a switch press when vehicle conditions are not correct for power operation, etc.	
BEC Status Feedback	Provides information on the state of the back end closure to other features within the vehicle. This information includes motion of the closure, obstacle detection, lock state, and can request the user to manually close the back end closure because the power operation is inhibited.	
BEC Manage Drift	Detects a falling gate and requests application of power to stop the gate from falling and then requests power close to return the gate to the closed position in a controlled manner.	
BEC Slam Protection	Detects manual movement of the gate and limits the speed of the manual movement by applying to power to slow the gate movement.	
BEC Obstacle Detection	Detects when the gate makes contact with an obstacle in the moving path of the gate and either reverses the gate movement (from close to open) or stops the gate movement (open to stop).	

Function Name	Description	Comments
BEC Determine Manual Mode	Provides the user with a means to disable the power operation of the gate through a menu selection in the message center.	

Table 17: List of Functions

7.2 Logical Architecture

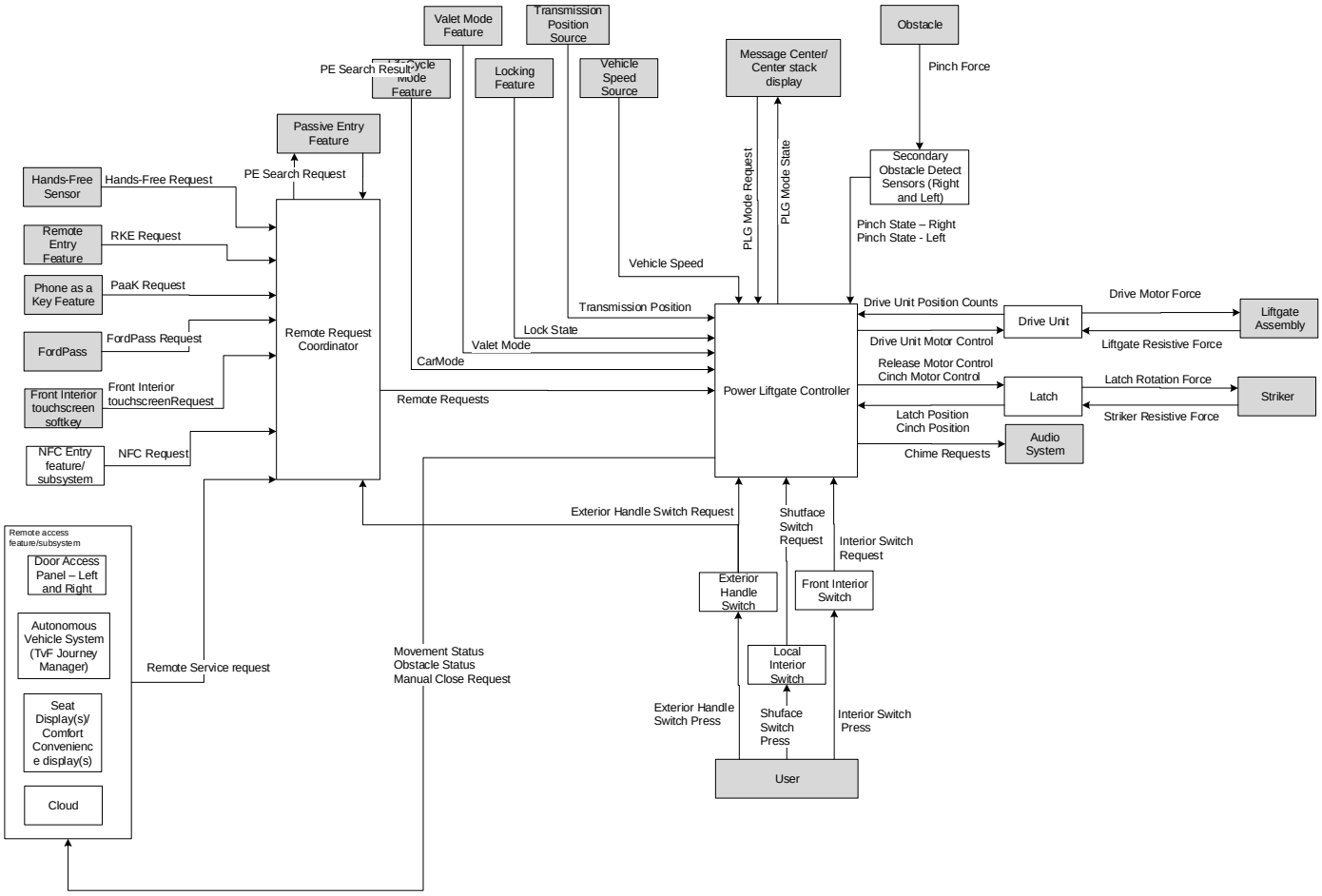

Figure 5: Logical Boundary Diagram

7.2.1 Logical Elements

Element Name	Description	Allocated Functions	Comments
Remote Request Coordinator	Receives and coordinates user requests where the user may not be in close proximity to the vehicle.	BEC Open/Close Requests BEC Service Handler BEC Exterior Switch Enable BEC Hands-Free Activation BEC center stack Open/Close requests	
Power Liftgate Controller	Main controller of the power liftgate system. Accepts user requests, verifies conditions allow for power operation and	BEC Validation of User Requests Arbitration of User Inputs BEC Position Programming Verify BEC Operation Preconditions	

	controls the latch and drive unit to perform the requested operation.	Determine BEC Move Request Control BEC Operation Power Open Power Close Power Release Power Cinch BEC Audible Feedback BEC Status Feedback BEC Manage Drift BEC Slam Protection BEC Obstacle Detection BEC Determine Manual Mode	
Secondary Obstacle Detection Sensors	Sensors that are typically mounted on the upper portion of the liftgate opening near the hinge point on either side of the liftgate. These sensors indicate when an object is contacting the liftgate opening, and are potentially in the closing path of the liftgate.	BEC Obstacle Detection	
Drive Unit	Motorized mechanism that applies force to the liftgate to move either open or closed. The drive unit also contains position sensor(s) to be used by the power liftgate controller to monitor liftgate position and speed.	Control BEC Operation Power Open Power Close BEC Obstacle Detection	
Latch	Mechanism to hold the liftgate closed when engaged to the striker. The latch is motorized to provide power release and power cinch operation. The latch has several position switches which are used by the power liftgate controller to monitor the latch position and cinch mechanism position.	Control BEC Operation Power Release Power Cinch	
Front Interior Switch	Momentary switch located in the front of the passenger cabin, typically on the instrument panel where it can be reached by a user in the driver's seat.	BEC Validation of User Requests	
Local Interior Switch	Momentary switch located on or near the liftgate. It is accessible from the exterior of the vehicle only when the liftgate is open.	BEC Validation of User Requests BEC Position Programming	
Exterior Handle Switch	Momentary switch located on or near the liftgate that is accessible from the exterior of the vehicle while the liftgate is closed.	BEC Validation of User Requests	

Table 18: Logical Elements

7.2.2 Logical Interfaces

Interface Name	Direction	Description	Value Range
Hands-Free Request	Input		ACTIVE | INACTIVE
RKE Request	Input		ACTIVE | INACTIVE
PaaK Request	Input		ACTIVE | INACTIVE
FordPass Request	Input		ACTIVE | INACTIVE
Front Interior touchscreen Request	Input		ACTIVE | INACTIVE

Remote Service Request	Input		OPEN | CLOSE | STOP |
NFC Request	Input		ACTIVE | INACTIVE
Movement Status	Output		OPENING | CLOSING | NOT_MOVING
Obstacle Status	Output		OBSTACLE | NO_OBSTACLE
Manual Close Request	Output		REQUEST_CLOSE | NO_REQUEST
Exterior Handle Switch Press	Input		ACTIVE | INACTIVE
Interior Switch Press	Input		ACTIVE | INACTIVE
Shutface Switch Press	Input		ACTIVE | INACTIVE
PE Search Request	Output		SEARCH | NULL
PE Search Result	Input		VALID | INVALID | NULL
Vehicle Speed	Input		0 to 655 kph
Transmission Position	Input		PARK | REVERSE | NEUTRAL | DRIVE
Lock State	Input		LOCK | UNLOCK
Valet Mode	Input		ACTIVE | INACTIVE
CarMode	Input		FACTORY | TRANSPORT | NORMAL
PLG Mode Request	Input		MANUAL | POWER
PLG Mode State	Output		MANUAL | POWER
Chime Requests	Output		LONG_CHIME | SHORT_CHIME | FAST_CHIME | REPEATED_CHIME | NO_CHIME
Pinch Force	Input		
Drive Motor Force	Output		
Liftgate Resistive Force	Input		
Latch Rotation Force	Output		
Striker Resistive Force	Input		

Table 19: Logical Interfaces

8 OPEN CONCERNS

ID	Concern Description	e-Tracker / Reference	Responsible	Status	Solution
1	Potential Security Issue: Exterior Switch press is allowed regardless of lock or enable state when the liftgae is open/ajar. Can the open/ajar state be spoofed, allowing a toggle request while the liftgate is physically closed?				
2	What is the rationale behind ECE markets treating the Front Interior Switch differently than other markets relative to the validation criteria (ECE requires doors to be unlocked, others use Trim Switch Inhibit)?				
3	Understand/document the Phone HMI for power liftgate activation from a phone as a key device.				
4	Question on Toggle operation: What happens if the gate is manually moved into the toggle region? Also, what happens if the gate is stopped in the toggle region and is manually moved to the opening or closing region?				
5	Is Tip to Close needed? If so, what is the criteria for calibration?				
6	Close requests from Remote Access Features/subsystems will be ignored while in the Open Only Region. How to get the liftgate closed in this situation?				
7	What is the rationale for queueing user request until cinch operation is complete?				
8	What is the rationale for allowing a user request to perform Unlatch only if the voltage is out of range for activating the drive motor? Should this be limited to the Exterior Switch only? Need to reconcile this with RQT-191001-009906-LOW/HIGH VOLTAGE GUARANTEED FUNCTION/PERFORMANCE.				
9	Can/should a power close operation be initiated due to a falling gate while in the Open Only region?				
10	Need to understand/document configurations and calibrations of the system.				
11	Are there any UX requirements? Also need to reconcile with power liftgate DNA.				
12	Need to add Use Cases for Service Technicians and VO Plant Personnel, and determine what requirements are needed to be added in Section 5.4.3.				
13	What is the criteria for setting the thresholds for the Open Only, Toggle and Close Only regions?				

ID	Concern Description	e-Tracker / Reference	Responsible	Status	Solution
14	Need to reconcile Manual Operating Efforts and Slam Abuse requirements. Reference RQT-011421-015378-MANUAL OPERATING EFFORTS RQT-011421-015391: REAR POWER CLOSURE SLAM ABUSE				
15	Thresholds for Slam Protection are currently determined to provide protection to the drive unit motor(s). There needs to be some constraint on the threshold to ensure manual movement can reasonably be achieved by a user. Need to understand what is considered acceptable manual movement.				

Table 20: Open Concerns

9 REVISION HISTORY

Rev. (revision)	Date	Description	Approved by	Responsible
001	*1/31/20*	*Initial version*		*DKING13*
002	*2/11/20*	*Added "Liftgate Weight" to Context Diagram. Modified Use-Cases to include verification of vehicle stationary, vehicle locked, passive entry device present, trim switch inhibit active as appropriate. Modified Use Case 7 to use Exterior Switch to Open liftgate.*		*DKING13*
003	*10/12/20*	*Added 'Front interior touchscreen softkey' to feature description, modified Use Case 3 to include Front interior touchscreen softkey controls to Open and close liftgate, modified Use Case 6 to inhibit Front interior touchscreen softkey when trim inhibit is active, added Toggle Operation requirement#66 for Front Interior touchscreen, added Power Liftgate Chime loudness and sound quality requirement #67, added center stack Liftgate Mode Selection requirement #68, added Liftgate Softkey selection requirement #69, modified requirement, modified requirement #53, 54 to include center stack for power mode, added Front interior touchscreen softkey contact size and spacing requirement #70, Renamed 'BEC Exterior Open/Close request' function to BEC 'Open/Close request'*		*KPURI*
004	*3/5/2021*	*Updated requirement #65 to reflect behavior change in Factory mode allowing liftgate power open/close (previous behavior was unlatch only)*		*KPURI*
005	*3/12/2021*	*Added 'Pre-commanded OOA feature' interface to context diagram, added use case 11 and modified use cases 1,2 for pre-commanded OOA request to PLG. Added requirement #71 for pre-commanded OOA*		*KPURI*
006	*5/7/2021*	*Added 'NFC Entry feature' interface to context diagram, modified use cases 1,2 for NFC request to PLG. Added requirement #72 for NFC*		*KPURI*
007	*5/7/2021*	*Updated feature overview, functional architecture, requirement 16,17,18 and added requirement 73,74,75,76,77 for DAP, DXP/CCD, Journey Manager, Cloud requests*		*KPURI*

10 APPENDIX

Document ends here.