Hazard ID	Situation Analysis						
	Operational Mode	**Operational Scenario**	**Environmental Details**	**Situation Details (optional)**	**Other Details (optional)**	**Item Usage (function)**	**Situation Description**
HA-001	OM03 - Normal Driving	OS01 - City Road	EN04 - Snowfall (degraded view)	SD03 - Low speed	Daytime or nighttime driving	IU01 - Correctly used	Normal Driving on City Road during Normal conditions with Low speed (Night time + Obstacle on the road)
HA-002	OM03 - Normal driving	OS02 - City Road	EN01 - Normal conditions	SD01 - Low speed	Heavy traffic city driving condition	IU01 - Correctly used	Normal driving condition in heavy city traffic with frequent lane changes
HA-003	OM03 - Normal driving	OS04 - Highway	EN02 - Sun blares (degraded view)	SD02 - High speed	Driving eastward or westward into the sun	IU01 - Correctly used	Normal highway high-speed driving condition driving into the sun.
HA-004	OM03 - Normal driving	OS04 - Highway	EN03 - Fog EN04 - Snowfall (degraded view)	SD02 - High speed	Driving in fog or snowfall	IU01 - Correctly used	Normal highway high-speed driving condition driving in fog or snowfall with very low visibility of lane lines.
HA-005	OM03 - Normal driving	OS09 - Road tunnel	EN01 - Normal conditions	SD02 - High speed	Driving into a tunnel from sunlight	IU01 - Correctly used	Normal highway high-speed driving condition driving into a tunnel from sunlight
HA-006	OM03 - Normal driving	OS05 - Mountain Pass	EN06-08 - Rain, Snow or Glace (slippery road)	SD02 - Low speed	Driving on mountain pass when road is slippery	IU01 - Correctly used	Normal highway high-speed driving condition driving on mountain pass road with slippery road conditions
HA-007	OM06 - Towing (active)	OS04 - Highway	EN06-08 - Rain, Snow or Glace (slippery road)	SD01 - Low speed	Driving on highway in rainy or snowy conditions with trailer load at back of the vehicle	IU01 - Correctly used	Normal highway high-speed driving condition with slipper road, but a heavy trailer load is at back of vehicle.
HA-008	OM03 - Normal driving	OS04 - Highway	EN01 - Normal conditions	SD02 - High speed	Driving on highway in normal conditions	IU02 - Incorrectly used	Normal highway high-speed driving condition. Driver attempts to use LKA function as an autonomous feature.

Hazard Identification					
Function	**Deviation**	**Deviation Details**	**Hazardous Event (resulting effect)**	**Event Details**	**Hazardous Event Description**
LDW function applies oscillating torque at a magnitude and frequency on steering wheel	DV19 - Sensor detection is wrong	LDW function fails to detect lane lines on the road	EV04-06 - Front collision with traffic or obstacle	Vehicle crashes into the traffic or obstacle with injury to driver	No LDW warning issued driver upon unintended departure from lane
LDW function applies oscillating torque at a magnitude and frequency on steering wheel	DV02 - Function unexpectedly activated	LDW function activates frequently	EV-07 - None	Driver is given multiple warnings due to lane changes in heavy traffic	Driver annoyance due to frequent LDW warning
LDW function applies oscillating torque at a magnitude and frequency on steering wheel	DV19 - Sensor detection is wrong	LDW function fails to detect lane lines on the road	EV04-06 - Front collision with traffic or obstacle	Vehicle crashes into the traffic or obstacle with injury to driver	No LDW warning issued driver upon unintended departure from lane
LDW function applies oscillating torque at a magnitude and frequency on steering wheel	DV19 - Sensor detection is wrong	LDW function fails to detect lane lines on the road due to fog, snowfall or snow covering lane lines	EV04-06 - Front collision with traffic or obstacle	Vehicle crashes into the traffic or obstacle with injury to driver	No LDW warning issued driver upon unintended departure from lane
LDW function applies oscillating torque at a magnitude and frequency on steering wheel	DV19 - Sensor detection is wrong	LDW function fails to detect lane lines on the road due to sudden change in lighting and exposure	EV04-06 - Front collision with traffic or obstacle	Vehicle crashes into the traffic or obstacle with injury to driver	No LDW warning issued driver upon unintended departure from lane
LKA function applies steering torque to keep the vehicle in the center of the lane	DV04 - Actor effect is too much	LKA function applies large mangnitude of torque due to high curvature of mountain pass roads in slipper conditions	EV03 - Car spins out of control	Vehicle spins out of control, may go off the road, hit an obstacle or worse fall off the moutain pass	LKA function applies large torque on slipper road leading to vehicle spinning out of control
LKA function applies steering torque to keep the vehicle in the center of the lane	DV04 - Actor effect is too much	LKA function applies large mangnitude of torque leading to destabalization of vehicle due to trailer load	EV03 - Car spins out of control	Vehicle spins out of control, may go off the road, hit an obstacle or worse collide with oncoming traffic	LKA function applies large torque on slippery road leading to vehicle spinning out of control
LKA function applies steering torque to keep the vehicle in the center of the lane	DV03 - Function always activated	Driver tries to use the LKA function as autonomous feature.	EV04-06 - Front collision with traffic or obstacle	Vehicle crashes into the traffic or obstacle with injury to driver	LKA function is misused as an autonomous feature in the vehicle

Hazardous Event Classification					
Exposure (of situation)	**Rationale (for exposure)**	**Severity (of potential harm)**	**Rationale (for severity)**	**Controllability (of hazardous event)**	**Rationale (for controllability)**
E2 - Low probability	Driving in snow on uncleared roads is rare event in an year	S2 - Severe and life-threatening injuries	In city speed can be high and collission with oncoming traffic can lead to major injury	C3 - Difficult to control or uncontrollable	Driver may not be able to assume sudden control in a stable manner due to snow that may lead to instability in vehicle.
E3 - Medium probability	City driving and lane change in low speed are common in few markets	S0 - No injuries	Speeds in heavy city traffic are very low	C0 - Controllable in general	Driver can gain contorl of vehicle at the low city (heavy) traffic
E3 - Medium probability	Highway speeds have very low time for reaction and risk is too high	S3 - Severe and life-threatning injuries	Possibility of collision with on-coming traffic at highway speeds	C3 - Difficult to control or uncontrollable	At high speeds driver may not gain steady control of the vehicle
E4 - High probability	Many people and many regions drive on highways in foggy or snowy conditions. Highway speeds have very low time for reaction and risk is too high.	S3 - Severe and life-threatning injuries	Possibility of collision with on-coming traffic at highway speeds	C3 - Difficult to control or uncontrollable	At high speeds driver may not gain steady control of the vehicle
E3 - Medium probability	Highway speeds have very low time for reaction and risk is too high	S3 - Severe and life-threatning injuries	Possibility of collision with on-coming traffic at highway speeds	C3 - Difficult to control or uncontrollable	At high speeds driver may not gain steady control of the vehicle
E2 - Low probability	Mountain pass driving in slippery conditions is a rare event	S3 - Severe and life-threatning injuries	Loss of control of vehicle on mountain pass could lead to vehicle going off the road, hitting obstacle or falling off the mountain.	C3 - Difficult to control or uncontrollable	Difficult to regain control of vehicle in slipper conditions
E2 - Low probability	Trailer loads are not used frequently especially when driving conditions are not too good	S3 - Severe and life-threatning injuries	Loss of control of vehicle on highway could lead to vehicle going off the road, hitting obstacle or colliding with oncoming traffic.	C3 - Difficult to control or uncontrollable	Difficult to regain control of vehicle in slippery conditions with trailer load at the back of the vehicle.
E4 - High probability	Drivers may confuse or misundrestand the LKA feature.	S3 - Severe and life-threatning injuries	Possibility of collision with on-coming traffic at highway speeds	C3 - Difficult to control or uncontrollable	Difficult to regain control of vehicle in slipper conditions

Determination of ASIL and Safety Goals	
ASIL Determination	**Safety Goal**
ASIL A	LDW function will disable and issue warning if lane lines are not visisble
QM	Disable LDW in very low speed congested traffic condition and warn driver (e.g. could use google maps traffic data too)
ASIL C	LDW function will disable and issue warning if lane lines are not visisble due to sun glare
ASIL D	LDW function will disable and issue warning if lane lines are not visisble due to fog or snow fall
ASIL C	LDW function will disable and issue warning if lane lines are not visisble due to fog or snow fall
ASIL B	LKA function can take inputs from chassis ECU (IMU or wheel spin data) on grade and temperature information and disable application of torque if snowy, slippery conditions are detected.
ASIL B	LKA function can use data from body controls ECU, chassis EDU to determine if trailer load is hooked and driving condition are not good. LKA will disable and issue warning to driver.
ASIL D	LKA function will apply steering torque for only a short duration.

Hazard & Risk Analysis Definitions

Operational Mode

ID	Mode	Remarks	Reference
OM01	Parked	Car is parked, ignition is off	OM01 - Parked
OM02	Ignition on	Car is parked, ignition is on	OM02 - Ignition on
OM03	Normal driving	Car is driving	OM03 - Normal driving
OM04	Backward driving	Car is driving	OM04 - Backward driving
OM05	Degraded driving	Limp home mode	OM05 - Degraded driving
OM06	Towing (active)	Towing another car	OM06 - Towing (active)
OM07	Towing (passive)	Beeing towed by another car	OM07 - Towing (passive)
OM08	Service	Vehicle is in repair garage	OM08 - Service
OM09	N/A	not applicable or not relevant	OM09 - N/A

Operational Scenario

ID	Scenario	Remarks	Reference
OS01	Any Road	road type	OS01 - Any Road
OS02	City Road	road type	OS02 - City Road
OS03	Country Road	road type	OS03 - Country Road
OS04	Highway	road type	OS04 - Highway
OS05	Mountain Pass	road type	OS05 - Mountain Pass
OS06	Off Road	road type	OS06 - Off Road
OS07	Road with gradient	road attribute	OS07 - Road with gradient
OS08	Road with bump	road attribute	OS08 - Road with bump
OS09	Road tunnel	road attribute	OS09 - Road tunnel
OS10	Road with construction	road attribute	OS10 - Road with construction
OS11	N/A	not applicable or not relevant	OS11 - N/A

Situation Details

ID	Scenario	Remarks	Reference
SD01	Low speed	driving attribute	SD01 - Low speed
SD02	High speed	driving attribute	SD02 - High speed
SD03	Normal acceleration	driving attribute	SD03 - Normal acceleration
SD04	High acceleration	driving attribute	SD04 - High acceleration
SD05	Normal braking	driving attribute	SD05 - Normal braking
SD06	High braking	driving attribute	SD06 - High braking
SD07	N/A	not applicable or not relevant	SD07 - N/A

Item Usage

ID	Mode	Remarks	Reference
IU01	Correctly used	Intended usage	IU01 - Correctly used
IU02	Incorrectly used	Unintended usage (foreseeable)	IU02 - Incorrectly used
IU03	N/A	not applicable or not relevant	IU03 - N/A

Environmental Details

ID	Scenario	Remarks	Reference
EN01	Normal conditions	weather attribute	EN01 - Normal conditions
EN02	Sun blares (degraded view)	weather attribute	EN02 - Sun blares (degraded view)
EN03	Fog (degraded view)	weather attribute	EN03 - Fog (degraded view)
EN04	Snowfall (degraded view)	weather attribute	EN04 - Snowfall (degraded view)
EN05	Cross-wind (lateral force)	weather attribute	EN05 - Cross-wind (lateral force)
EN06	Rain (slippery road)	road attribute	EN06 - Rain (slippery road)
EN07	Snow (slippery road)	road attribute	EN07 - Snow (slippery road)
EN08	Glace (slippery road)	road attribute	EN08 - Glace (slippery road)
EN09	N/A	not applicable or not relevant	EN09 - N/A

Deviation

ID	Deviation (Guideword)	Remarks	Reference
DV01	Function not activated	Activation error	DV01 - Function not activated
DV02	Function unexpectedly activated	Activation error	DV02 - Function unexpectedly activated
DV03	Function always activated	Activation error	DV03 - Function always activated
DV04	Actor effect is too much	Quantitative error	DV04 - Actor effect is too much
DV05	Actor effect is too less	Quantitative error	DV05 - Actor effect is too less
DV06	Actor action too early	Timing error	DV06 - Actor action too early
DV07	Actor action too late	Timing error	DV07 - Actor action too late
DV08	Actor action before	Sequence error	DV08 - Actor action before
DV09	Actor action after	Sequence error	DV09 - Actor action after
DV10	Actor effect is reverse	Logical error	DV10 - Actor effect is reverse
DV11	Actor effect is wrong	Logical error	DV11 - Actor effect is wrong
DV12	Sensor sensitivity is too high	Quantitative error	DV12 - Sensor sensitivity is too high
DV13	Sensor sensitivity is too low	Quantitative error	DV13 - Sensor sensitivity is too low
DV14	Sensor detection too early	Timing error	DV14 - Sensor detection too early
DV15	Sensor detection too late	Timing error	DV15 - Sensor detection too late
DV16	Sensor detection before	Sequence error	DV16 - Sensor detection before
DV17	Sensor detection after	Sequence error	DV17 - Sensor detection after
DV18	Sensor detection is reverse	Logical error	DV18 - Sensor detection is reverse
DV19	Sensor detection is wrong	Logical error	DV19 - Sensor detection is wrong
DV20	N/A	Not Applicable	DV20 - N/A

Hazardous Events (possibe effects)

ID	Hazardous Event	Remarks	Reference
EV-07	None		EV-07 - None
EV-06	Front collision with oncoming traffic		EV-06 - Front collision with oncoming traffic
EV-05	Front collision with ahead traffic		EV-05 - Front collision with ahead traffic
EV-04	Front collision with obstacle		EV-04 - Front collision with obstacle
EV-03	Rear collision with trailing traffic		EV-03 - Rear collision with trailing traffic
EV-02	Side collision with other traffic		EV-02 - Side collision with other traffic
EV-01	Side collision with obstacle		EV-01 - Side collision with obstacle
EV00	Collision with other vehicle		EV00 - Collision with other vehicle
EV01	Collision with train		EV01 - Collision with train
EV02	Collision with pedestrian		EV02 - Collision with pedestrian
EV03	Car spins out of control		EV03 - Car spins out of control
EV04	Car comes off the road		EV04 - Car comes off the road
EV05	Car catches file		EV05 - Car catches file
EV06	N/A		EV06 - N/A

Exposure

ID	Description	Duration (of situation)	Frequency (of situation)	Reference
E0	Incredible			E0 - Incredible
E1	Very low probability	Not specified	Occurs less often than once a year for the great majority of drivers	E1 - Very low probability
E2	Low probability	<1 % of average operating time	Occurs a few times a year for the great majority of drivers	E2 - Low probability
E3	Medium probability	1 % to 10 % of average operating time	Occurs once a month or more often for an average driver	E3 - Medium probability
E4	High probability	>10 % of average operating time	Occurs during almost every drive on average	E4 - High probability

Severity

ID	Description	Remarks	Probability of Injuries	Reference
S0	No injuries	No injuries	AIS 0 and less than 10 % probability of AIS 1-6	S0 - No injuries
S1	Light and moderate injuries	Light and moderate injuries	More than 10 % probability of AIS 1-6 (and not S2 or S3)	S1 - Light and moderate injuries
S2	Severe and life-threatening injuries	Severe and life-threatening injuries (survival probable)	More than 10 % probability of AIS 3-6 (and not S3)	S2 - Severe and life-threatening injuries
S3	Life-threatening or fatal injuries	Life-threatening injuries (survival uncertain), fatal injuries	More than 10 % probability of AIS 5-6	S3 - Life-threatening or fatal injuries

Controllability

ID	Description	Remarks	Reference
C0	Controllable in general	Controllable in general	C0 - Controllable in genera
C1	Simply controllable	99 % or more of all drivers or other traffic participants are usually able to avoid harm	C1 - Simply controllable
C2	Normally controllable	90 % or more of all drivers or other traffic participants are usually able to avoid harm	C2 - Normally controllable
C3	Difficult to control or uncontrollable	Less than 90 % of all drivers or other traffic participants are usually able, or barely able, to avoid harm	C3 - Difficult to control or uncontrollable

Controllability	Exposure	Severity			
		S0	S1	S2	S3
C1	E1	QM	QM	QM	QM
	E2	QM	QM	QM	QM
	E3	QM	QM	QM	A
	E4	QM	QM	A	B
C2	E1	QM	QM	QM	QM
	E2	QM	QM	QM	A
	E3	QM	QM	A	B
	E4	QM	A	B	C
C3	E1	QM	QM	QM	A
	E2	QM	QM	A	B
	E3	QM	A	B	C
	E4	QM	B	C	D