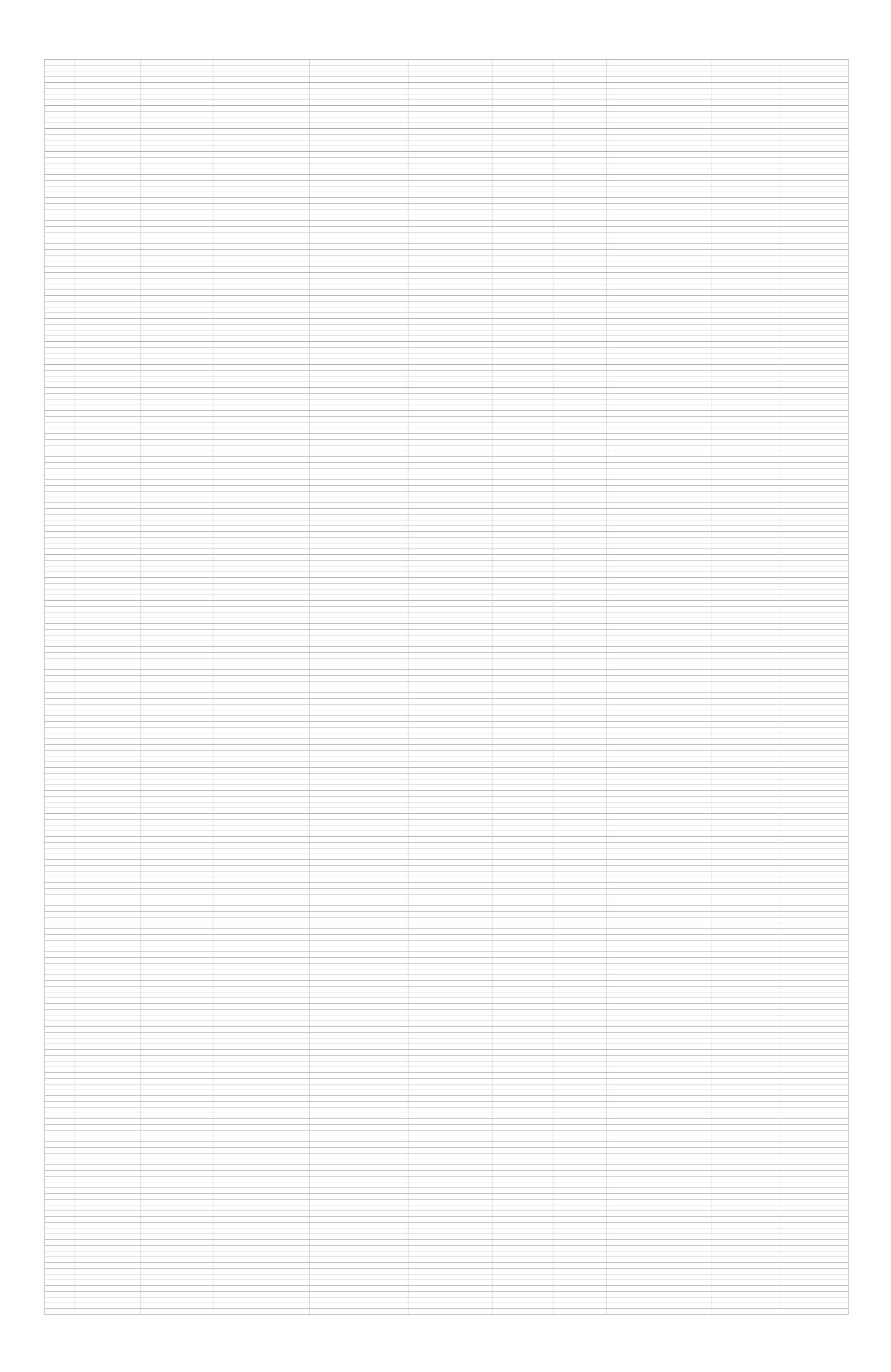
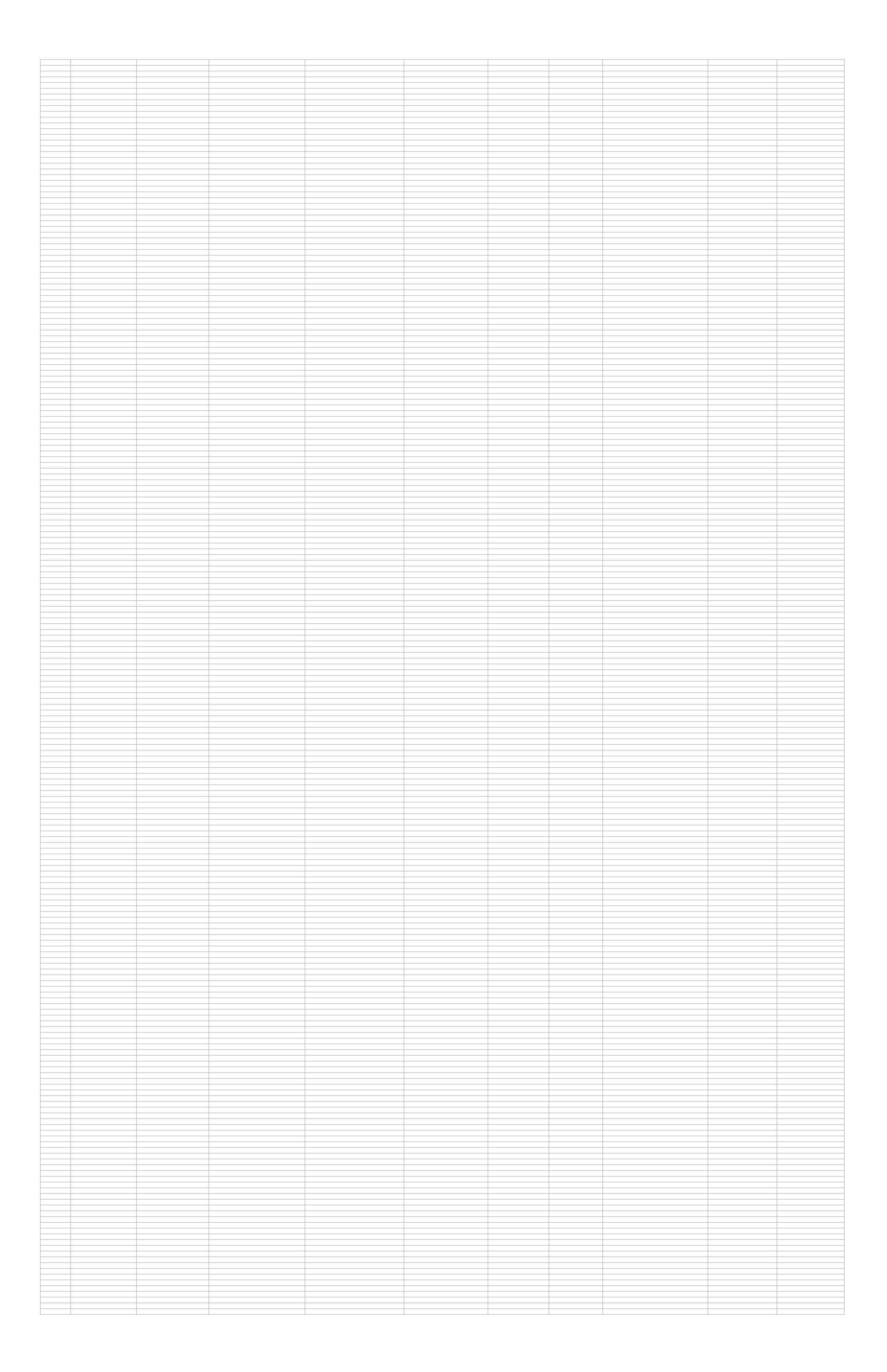
|           | INSTRUCTIONS:                |                             |                          |                         |  |                          | I   |  |                        |                              |                                       |   |                             |
|-----------|------------------------------|-----------------------------|--------------------------|-------------------------|--|--------------------------|---|--|------------------------|------------------------------|---------------------------------------|---|-----------------------------|
|           | Fill out the hazard analysis | and risk assessment hel     | low                      |                         |  |                          |   |  |                        |                              |                                       |   |                             |
|           | HA-001 should be for the l   |                             |                          | the lecture.            |  |                          |   |  |                        |                              |                                       |   |                             |
|           | HA-002 should be for the l   |                             |                          |                         |  |                          |   |  |                        |                              |                                       |   |                             |
|           | Then come up with your o     |                             |                          |                         | -003 and HA-004 rows.  |                          |   |  |                        |                              |                                       |   |                             |
|           | When finished, export you    | r spreadsheet as a pdf file | e so that a reviewer car | n easily see your work. |  |                          |   |  |                        |                              |                                       |   |                             |
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|           |                              |                             |                          |                         |  |                          |   |  |                        |                              |                                       |   |                             |
| Hazard ID |                              |                             |                          | Situational Ana         | alysis   |                          |   |  |                        |                              | Hazard Identification                 |   |                             |
|           | Operational Mode             | Operational Scenario        | Environmental<br>Details | Situation Details       | Other Details<br>(optional)  | Item Usage<br>(function) | Situation Description   | Function                                     | Deviation              | Deviation Details            | Hazardous Event<br>(resulting effect) | Event Details   | Hazardous Event Description |
| HA-001    | Normal Driving               | City Road                   | Normal Conditions        | Low Speed               | Night time + Obstacle on the road  | Correctly Used           | Normal Driving on a City Road in Normal Conditions at Low Speed at Night with an Obstacle on the Road                           | Low beam illuminates the roadway in the dark | Function not activated | Both headlights stop working | Front collision with obstacle         | Vehicle crashes into the obstacle with injury to driver   | Total loss of low beam      |
| HA-002    | Normal Driving               | Country Road                | Normal Conditions        | High speed              | Night time + Obstacle<br>on the road and no<br>other illumination on<br>road | Correctly used           | Normal Driving on Country Road during<br>Normal conditions with High speed (Night<br>time + Oncoming vehicle)                   | Low beam illuminates the roadway in the dark | Function not activated | Both headlights stop working | Collision with other vehicle          | Vehicle crashes into the oncoming vehicle or road infrastructure                                      | Total loss of low beam      |
| HA-003    | Normal Driving               | Highway                     | Snowfall (degraded view) | High speed              | Night time + Obstacle<br>on the road or<br>upcoming curve                    | Correctly used           | Normal Driving on Highway during Snowfall (degraded view) with High speed (Night time + Obstacle on the road or upcoming curve) | the readway in the dark                      | Function not activated | Both headlights stop working | Front collision with obstacle         | Vehicle crashes into the obstacle or road infrastructure with injury to driver and any others present | Total loss of low beam      |
| HA-004    | Normal Driving               | Country Road                | Normal conditions        | High speed              | Night time + Oncoming vehicle  | Correctly used           | Normal Driving on Country Road during<br>Normal conditions with High speed (Night<br>time + Oncoming vehicle)                   | Low beam illuminates the roadway in the dark | Function not activated | Both headlights stop working | Collision with other vehicle          | Vehicle crashes into the oncoming vechile or road infrastructure                                      | Total loss of low beam      |

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|                          |   |   | rdous Event Classificat  |                                      |   |                    | nation of ASIL and Safety Goals           |  |  |  |
| Exposure (of situation)  | Rationale<br>(for exposure)   | Severity<br>(of potential harm)         | Rationale (for severity)                                       | Controllability (of hazardous event) | Rationale<br>(for controllability)  | ASIL Determination | Safety Goal                               |  |  |  |
| E4 - High<br>probability | night driving in the city is a regular activity   | S1 - Light and moderate injuries        | In city traffiic, speed of vehicle is expected to be low       | C0 - Controllable in general         | At city speed, most drivers will be able to control the situation by applying brakes and there is additional illmunitation on city roads  | QM                 | Total Loss of Beam Shall Be Prevented     |  |  |  |
| E4 - High<br>probability | night driving in the city on completely unilluminated roads while it is snowing is rare | S3 - Life-threatening or fatal injuries | On country roads speed of vehicle is expected to be high       | C1 - Simply controllable             | Since there is usually no other form of illumination to be expected on country road, it will be difficult for the average driver to control the vehicle in such a   | В                  | Total loss of low beam shall be prevented |  |  |  |
| E2 - Low<br>probability  | High driving is part of regular driving, however, heavy snow occurs a few times a year  | S3 - Life-threatening or fatal injuries | On highway speed of vehicle is expected to be high             | C2 - Normally controllable           | When driving on highway with low beam, it can be expected that there are other vehicles and there is some form of illumination on road and hence >90% drivers are able to brake and control the vehicle. And also use other forms of warning (e.g. hazard lights) to signal malfunction | А                  | Total loss of low beam shall be prevented |  |  |  |
| E4 - High<br>probability | country driving is part of regular driving  | S3 - Life-threatening or fatal injuries | On country roads<br>speed of vehicle is<br>expected to be high | C1 - Simply controllable             | Since there is usually no other form of illumination to be expected on country road, it will be difficult for the average driver to control the vehicle in such a situation   | В                  | Total loss of low beam shall be prevented |  |  |  |

| EXAMPLE DISCUSSED IN THE   | PROJECT INSTRUCTIONS - Head  | dlamp System   |   |   |   |  |  |  |  |
|----------------------------|--|--|---|---|---|--|--|--|--|
| Hazard ID  HA-001          | Operational Mode  Normal Driving   | Operational Scenario  City Road  | Environmental Details  Normal Conditions  | Situational Analysis Situation Details (optional) Low Speed | Other Details<br>(optional)<br>Night time + Obstacle on the | Item Usage<br>(function)<br>Correctly Used     | Situation Description  Normal Driving on a City Road in Normal   | Function  Low beam illuminates the   | Deviation Function not activated   |
| MORE EXAMPLES - Headlamp S | System   |  |   | Situation Analysis  |   |  |  |  |  |
| HA-001<br>HA-002<br>HA-003 | Operational Mode OM03 - Normal Driving OM03 - Normal Driving OM03 - Normal Driving | Operational Scenario  OS01 - City Road  OS01 - City Road  OS03 - Highway | Environmental Details  EN01 - Normal conditions  EN04 - Snowfall (degraded view)  EN04 - Snowfall (degraded view) | SD03 - Low speed<br>SD03 - High speed                       | Night time + Obstacle on the Night time + Obstacle on the   | IU01 - Correctly used<br>IU01 - Correctly used | Situation Description  Normal Driving on City Road during Normal  Normal Driving on City Road during Snowfall  Normal Driving on Highway during Snowfall | Function  Low beam illuminates the  Low beam illuminates the  Low beam illuminates the | Deviation  DV01 - Function not activated  DV01 - Function not activated  DV01 - Function not activated |
| HA-004<br>HA-005           | OM03 - Normal Driving<br>OM03 - Normal Driving                                     | OS02 - Country Road<br>OS02 - Country Road                               | EN01 - Normal conditions<br>EN04 - Snowfall (degraded view)   | SD02 - High speed<br>SD04 - High speed                      | Night time + Oncoming Night time + Obstacle on the          | IU01 - Correctly used<br>IU01 - Correctly used | Normal Driving on Country Road during Normal Normal Driving on Country Road during Snowfall  | Low beam illuminates the Low beam illuminates the                                      | DV01 - Function not activated DV01 - Function not activated  |
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| Deviation Details  Both headlights stop working  | Hazardous Event (resulting effect) Front collision with obstacle   | Event Details  Vehicle crashes into the   | Hazardous Event Description Total loss of low beam | Exposure<br>(of situation)<br>E4 - High probability   | Rationale (for exposure) night driving in the city is a regular   | Severity (of potential harm) S1 - Light and moderate injuries   | Rationale (for severity)  In city traffiic, speed of vehicle is expected to be low   | Controllability (of hazardous event)  C0 - Controllable in general   |
|--|--|---|--|---|---|---|--|--|
| Both headlights stop working Both headlights stop working Both headlights stop working | Hazardous Event (resulting effect)  EV04 - Front collision with obstacle  EV04 - Front collision with obstacle  EV04 - Front collision with obstacle | Event Details  Vehicle crashes into the Vehicle crashes into the Vehicle crashes into the | Total loss of low beam  Total loss of low beam     | Exposure (of situation)  E4 - High probability  E1 - Very low probability  E2 - Low probability | Rationale (for exposure)  night driving in the city is a regular night driving in the city on High driving is part of regular | Severity (of potential harm)  S1 - Light and moderate injuries S1 - Light and moderate injuries S3 - Life-threatening or fatal injuries | Rationale (for severity)  In city traffiic, speed of vehicle is expected to be low In city traffiic, speed of vehicle is expected to be low On highway speed of vehicle is expected to be high | Controllability (of hazardous event)  C0 - Controllable in general  C1 - Simply controllable  C2 - Normally controllable |
| Both headlights stop working  Both headlights stop working                             | EV08 - Collision with other vehicle EV04 - Front collision with obstacle   | Vehicle crashes into the Vehicle crashes into the   | Total loss of low beam  Total loss of low beam     | E4 - High probability E2 - Low probability  | country driving is part of regular country driving is part of regular   | S3 - Life-threatening or fatal injuries S3 - Life-threatening or fatal injuries   | On country roads speed of vehicle is expected to be high On country roads speed of vehicle is expected to be high  | C1 - Simply controllable C3 - Difficult to control or uncontrollable   |
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| Rationale<br>(for controllability)  | Determination of ASIL and ASIL Determination    | Safety Goal  |  |  |  |
|---|---|--|--|--|--|
| At city speed, most drivers will be able to   | QM  | Total Loss of Beam Shall   |  |  |  |
|   | Determination of ASII and                       | Safaty Caala   |  |  |  |
| Rationale (for controllability) At city speed, most drivers will be able to   | Determination of ASIL and ASIL Determination QM | Safety Goal  Total loss of low beam                                  |  |  |  |
| On completely unilluminated city roads, When driving on highway with low beam, it Since there is usually no other form of | QM<br>A<br>B                                    | Total loss of low beam Total loss of low beam Total loss of low beam |  |  |  |
| Since there is usually no other form of   | В   | Total loss of low beam   |  |  |  |
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| Hazard               | & Risk Analysis Definit  | ions   |   |   |  |
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| Operational          | I Mode   |  |   |   |  |
| ID<br>OM01           |  | Remarks Car is parked, ignition is off Car is parked, ignition is on | Reference OM01 - Parked OM02 - Ignition on  |   |  |
| OM03<br>OM04         | Normal driving Backward driving                                      | Car is driving Car is driving  | OM03 - Normal driving OM04 - Backward driving   |   |  |
| OM05<br>OM06         | Degraded driving Towing (active) Towing (passive)                    | Limp home mode Towing another car Beeing towed by another car        | OM05 - Degraded driving OM06 - Towing (active) OM07 - Towing (passive)                    |   |  |
| OM08                 | Service N/A  | Vehicle is in repair garage not applicable or not relevant           | OM07 - Towing (passive) OM08 - Service OM09 - N/A   |   |  |
| Operational          |  |  |   |   |  |
| ID<br>OS01           | Scenario<br>Any Road   | road type  | Reference<br>OS01 - Any Road  |   |  |
| OS02<br>OS03         | City Road Country Road   | road type<br>road type   | OS02 - City Road<br>OS03 - Country Road   |   |  |
| OS06                 | Highway<br>Mountain Pass<br>Off Road                                 | road type road type road type  | OS04 - Highway<br>OS05 - Mountain Pass<br>OS06 - Off Road                                 |   |  |
| OS07<br>OS08         | Road with gradient Road with bump                                    | road attribute road attribute  | OS07 - Road with gradient OS08 - Road with bump   |   |  |
| OS09<br>OS10         | Road tunnel Road with construction site                              | road attribute road attribute not applicable or not relevant         | OS09 - Road tunnel OS10 - Road with construction site OS11 - N/A                          |   |  |
|                      |  | Inot applicable of not relevant                                      | OSTI - N/A  |   |  |
|                      | Scenario   |  | Reference   |   |  |
| SD01<br>SD02<br>SD03 | Low speed High speed Normal acceleration                             | driving attribute driving attribute driving attribute                | SD01 - Low speed SD02 - High speed SD03 - Normal acceleration                             |   |  |
| SD04<br>SD05         | High acceleration  Normal braking                                    | driving attribute driving attribute                                  | SD04 - High acceleration<br>SD05 - Normal braking   |   |  |
| SD06<br>SD07         | High braking N/A   | driving attribute not applicable or not relevant                     | SD06 - High braking<br>SD07 - N/A   |   |  |
| Item Usage           |  |  |   |   |  |
| IU01                 | Correctly used   | Intended usage   | Reference IU01 - Correctly used IU02 - Incorrectly used                                   |   |  |
| IU03                 | Incorrectly used N/A   | Unintended usage (foreseeable) not applicable or not relevant        | IU03 - N/A  |   |  |
| Environmen           | ntal Details<br>  Scenario   | Remarks  | Reference   |   |  |
| EN01<br>EN02         | Normal conditions Sun blares (degraded view)                         | weather attribute weather attribute                                  | EN01 - Normal conditions<br>EN02 - Sun blares (degraded view)                             |   |  |
| EN03<br>EN04         | Fog (degraded view) Snowfall (degraded view)                         | weather attribute weather attribute                                  | EN03 - Fog (degraded view) EN04 - Snowfall (degraded view)                                |   |  |
| EN06                 | Cross-wind (lateral force) Rain (slippery road) Snow (slippery road) | road attribute   | EN05 - Cross-wind (lateral force) EN06 - Rain (slippery road) EN07 - Snow (slippery road) |   |  |
| EN08<br>EN09         | Snow (slippery road) Glace (slippery road) N/A                       | road attribute not applicable or not relevant                        | EN07 - Snow (slippery road)<br>EN08 - Glace (slippery road)<br>EN09 - N/A                 |   |  |
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| Deviation ID    | Deviation (Guideword)   | Remarks  | Reference   |  |  |          |  |
| DV01<br>DV02    | Function not activated Function unexpectedly activated                                  | Activation error Activation error                  | DV01 - Function not activated DV02 - Function unexpectedly activated  |  |  |          |  |
| DV04            | Function always activated  Actor effect is too much                                     | Activation error  Quantitative error               | DV03 - Function always activated DV04 - Actor effect is too much  |  |  |          |  |
| DV06            | Actor effect is too less Actor action too early Actor action too late                   | Quantitative error Timing error Timing error       | DV05 - Actor effect is too less DV06 - Actor action too early DV07 - Actor action too late                                    |  |  |          |  |
| DV08<br>DV09    | Actor action before Actor action after  | Sequence error Sequence error                      | DV08 - Actor action before DV09 - Actor action after  |  |  |          |  |
| DV11            | Actor effect is reverse  Actor effect is wrong  | Logical error  Logical error                       | DV10 - Actor effect is reverse  DV11 - Actor effect is wrong  |  |  |          |  |
| DV13            | Sensor sensitivity is too high Sensor sensitivity is too low Sensor detection too early | Quantitative error Quantitative error Timing error | DV12 - Sensor sensitivity is too high DV13 - Sensor sensitivity is too low DV14 - Sensor detection too early                  |  |  |          |  |
| DV15            | Sensor detection too late Sensor detection before                                       | Timing error Sequence error                        | DV15 - Sensor detection too late DV16 - Sensor detection before   |  |  |          |  |
| DV17<br>DV18    | Sensor detection after Sensor detection is reverse                                      | Sequence error Logical error                       | DV17 - Sensor detection after DV18 - Sensor detection is reverse  |  |  |          |  |
|                 | Sensor detection is wrong N/A   | Logical error not applicable or not relevant       | DV19 - Sensor detection is wrong DV20 - N/A   |  |  |          |  |
| Harandaya Eyest | (marsiles effects)  |  |   |  |  |          |  |
| ID              | s (possibe effects)  Hazardous Event None   | Remarks  | Reference<br>EV-07 - None   |  |  |          |  |
| EV-06<br>EV-05  | Front collision with oncoming traffic Front collision with ahead traffic                |  | EV-06 - Front collision with oncoming traffic   |  |  |          |  |
| EV-04<br>EV-03  | Front collision with obstacle Rear collision with trailing traffic                      |  | EV-05 - Front collision with ahead traffic EV-04 - Front collision with obstacle EV-03 - Rear collision with trailing traffic |  |  |          |  |
| EV-01           | Side collision with other traffic Side collision with obstacle                          |  | EV-02 - Side collision with other traffic EV-01 - Side collision with obstacle  |  |  |          |  |
| EV01            | Collision with other vehicle Collision with train Collision with pedestrian             |  | EV00 - Collision with other vehicle EV01 - Collision with train EV02 - Collision with pedestrian                              |  |  |          |  |
| EV03            | Car spins out of control Car comes off the road   |  | EV03 - Car spins out of control EV04 - Car comes off the road   |  |  |          |  |
| EV05            | Car catches file N/A  |  | EV05 - Car catches file EV06 - N/A  |  |  |          |  |
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| Exposure        |  |   |  |   |  |  |  |
|-----------------|--|---|--|---|--|--|--|
| ID              | Description                            | Duration (of situation)   | Frequency (of situation)   | Reference                                   |  |  |  |
| E0              | Incredible                             | , in the second | , i i  | E0 - Incredible                             |  |  |  |
| E1              | Very low probability                   | Not specified   | Occurs less often than once a year for the great majority of drivers |   |  |  |  |
| 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 general                |  |  |  |
| C1              | Simply controllable                    | 99 % or more of all drivers or other traffic participants are usuall  | y able to avoid harm   | C1 - Simply controllable                    |  |  |  |
| C2              | Normally controllable                  | 90 % or more of all drivers or other traffic participants are usuall  |  | C2 - Normally controllable                  |  |  |  |
| C3              | Difficult to control or uncontrollable | Less than 90 % of all drivers or other traffic participants are usual   | ally able, or barely able, to avoid harm                             | C3 - Difficult to control or uncontrollable |  |  |  |

| Controllability | Exposure | Severity |    |    |    |  |  |  |
|-----------------|----------|----------|----|----|----|--|--|--|
| Controllability | Lxposure | S0       | S1 | S2 | S3 |  |  |  |
|                 | E1       | QM       | QM | QM | QM |  |  |  |
| C1              | E2       | QM       | QM | QM | QM |  |  |  |
|                 | E3       | QM       | QM | QM | Α  |  |  |  |
|                 | E4       | QM       | QM | Α  | В  |  |  |  |
|                 | E1       | QM       | QM | QM | QM |  |  |  |
| C2              | E2       | QM       | QM | QM | Α  |  |  |  |
| 62              | E3       | QM       | QM | Α  | В  |  |  |  |
|                 | E4       | QM       | Α  | В  | С  |  |  |  |
|                 | E1       | QM       | QM | QM | Α  |  |  |  |
| j               | E2       | QM       | QM | А  | В  |  |  |  |
| C3              | E3       | QM       | Α  | В  | С  |  |  |  |
|                 | E4       | QM       | В  | С  | D  |  |  |  |