1a

By skipping the opt-body and selecting the first operand of the xalt we get a positive trace of length 20.

1b

Only the second operand of the xalt gives negative traces. The shortest negative trace of the assert is the empty trace. By the rule of weak sequencing it follows that the shortest possible negative trace is of length 20.

1c

By the rules of weak sequencing and the semantics of opt

!Readings

!Job schedule this month

1d

Same as 1c.

1e

Wrt the first operand of the xalt there are two possibilities due to weak sequencing:

?Reading

?Alarm off

Wrt the fsecond operand of the xalt there are two possibilities due to weak sequencing:

?Returning shipment

?Returning shipment

The last two events are on different lifelines.

1f

We only need to consider the second alt operand. Due to weak sequencing, we get ?Returning as the last event on the lifeline Truck Company, while there cannot be a last event on Truck Driver. With respect to the three other lifelines any reception event for a message sent by one of the other lifelines or a reception or send event with respect to a message from or to a gate may occur as the last event.

2a

It is a pure narrowing since the traces corresponding to skipping the opt-body are kept, while the traces that corresponds to executing the opt-body are made negative (the ones that are already negative remain negative).

2b

It is a supplementing since every inconclusive trace that is not in the semantics of the opt-body is made negative. It is also a narrowing since the behaviour corresponding to skipping the opt-body is made negative.

2c

It is a pure supplementing since the opt corresponds to looping either 0 or 1 time.

2d

The problem is that the state machine does not allow the body of the opt to be skipped. Hence, we need to add a transition from Init to await evidence with the decoration:

Alarm/Inspect

2e

It is not a refinement since the transition

Alarm still on/Inspect

is specified as negative by the sequence diagram.

2f

Extend the xalt with a third operand that is not a refinement of the first two oprands.