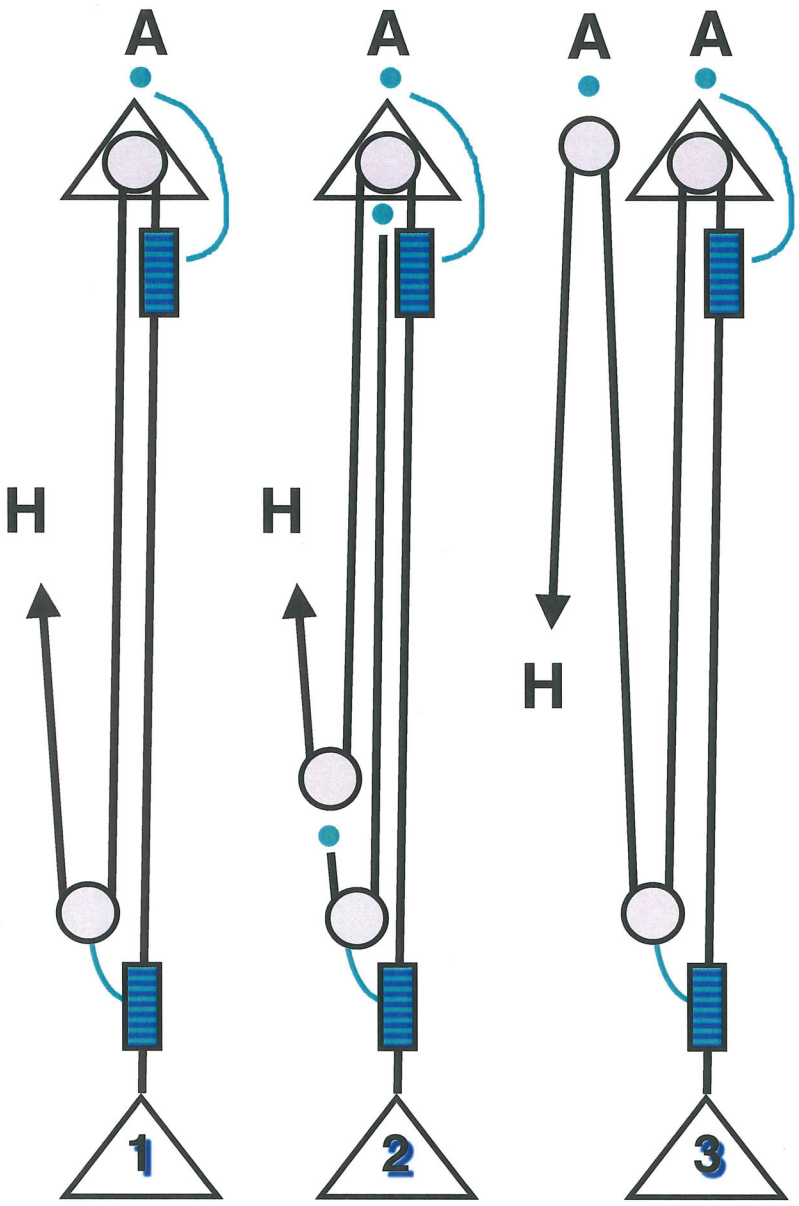
APPENDIX 2. ILLUSTRATIONS

2.1 RIGGING ILLUSTRATIONS

2.1.A MECHANICAL ADVANTAGE

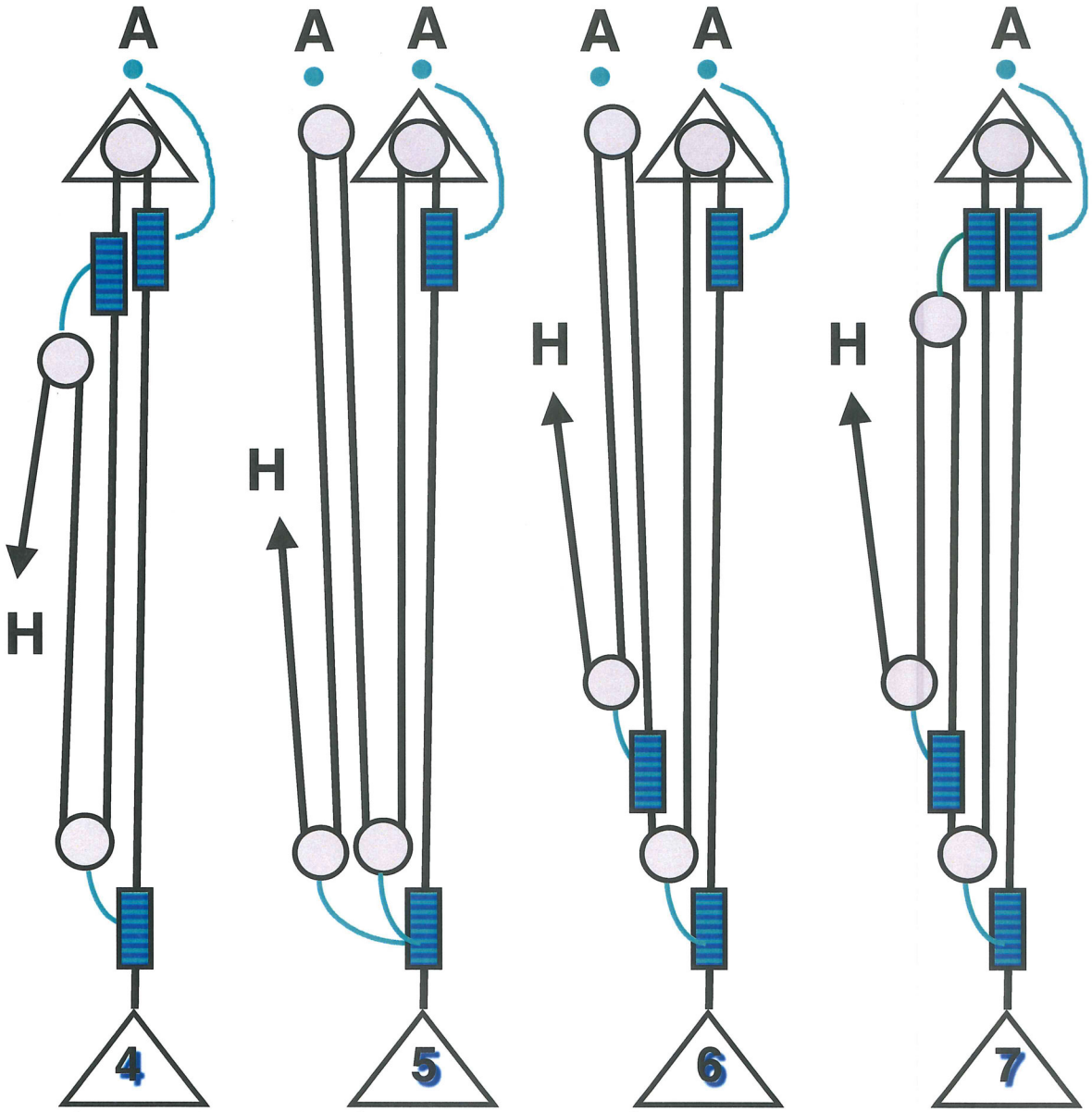
Creating mechanical advantage is necessary to reduce the amount of strength required to lift heavy loads. There is a multitude of devices out there that can be purchased which have mechanical advantage built into them; consider a block and tackle or a capstan winch.

While these devices tend to do most of the work for you, especially if powered, they are not recommended for most common rescue attempts because it is not easy for the person using the device to notice the increased resistance if someone or something has become stuck while moving. This can lead to very serious consequences if not noticed such as breaking and arm or leg or worse.



Simple 3 Way | Complex 5:1 | Simple 3:1 With Change of Direction

With that said, a rescue attempt usually means that someone's life in immediate jeopardy and careful consideration should be put into (1) what equipment is on hand, (2) who is properly trained on it, and (3) how dire the emergency is. Still. many at height workers do not have these mechanical devices on hand, and knowing how to create mechanical advantage with ropes and pulleys is one of the most important skills a worker can have when a rescue is necessary. Building mechanical advantage with ropes and pulleys can be very simple once trained and it should be a skill that all tower workers possess.

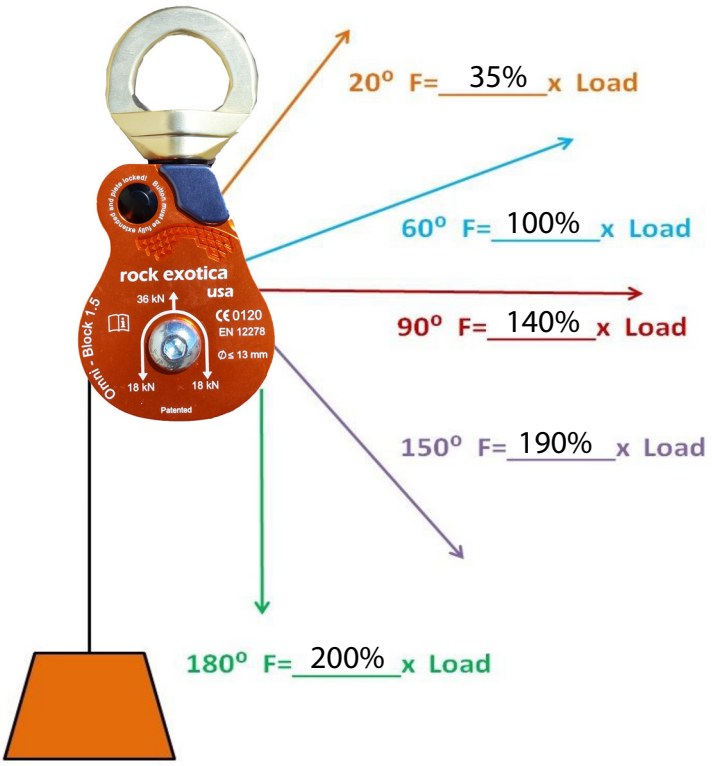


2.1.B VECTOR FORCES

What is a Vector Force?

Answer: A quantity possessing magnitude and direction.

Now that you understand how to build mechanical advantage systems and how to use them to your advantage, you must also understand the limitations and dangers that apply to using them. We will now look at the forces generated when moving loads in multiple directions. Since we can easily create a large amount of mechanical advantage, we now need to understand the Resultant Forces that we generate on the equipment. If you haven't heard of the Critical Angle before you should add it to your vocabulary now as it will become essential to recognizing dangerous situations while using standard rigging and hoisting techniques.



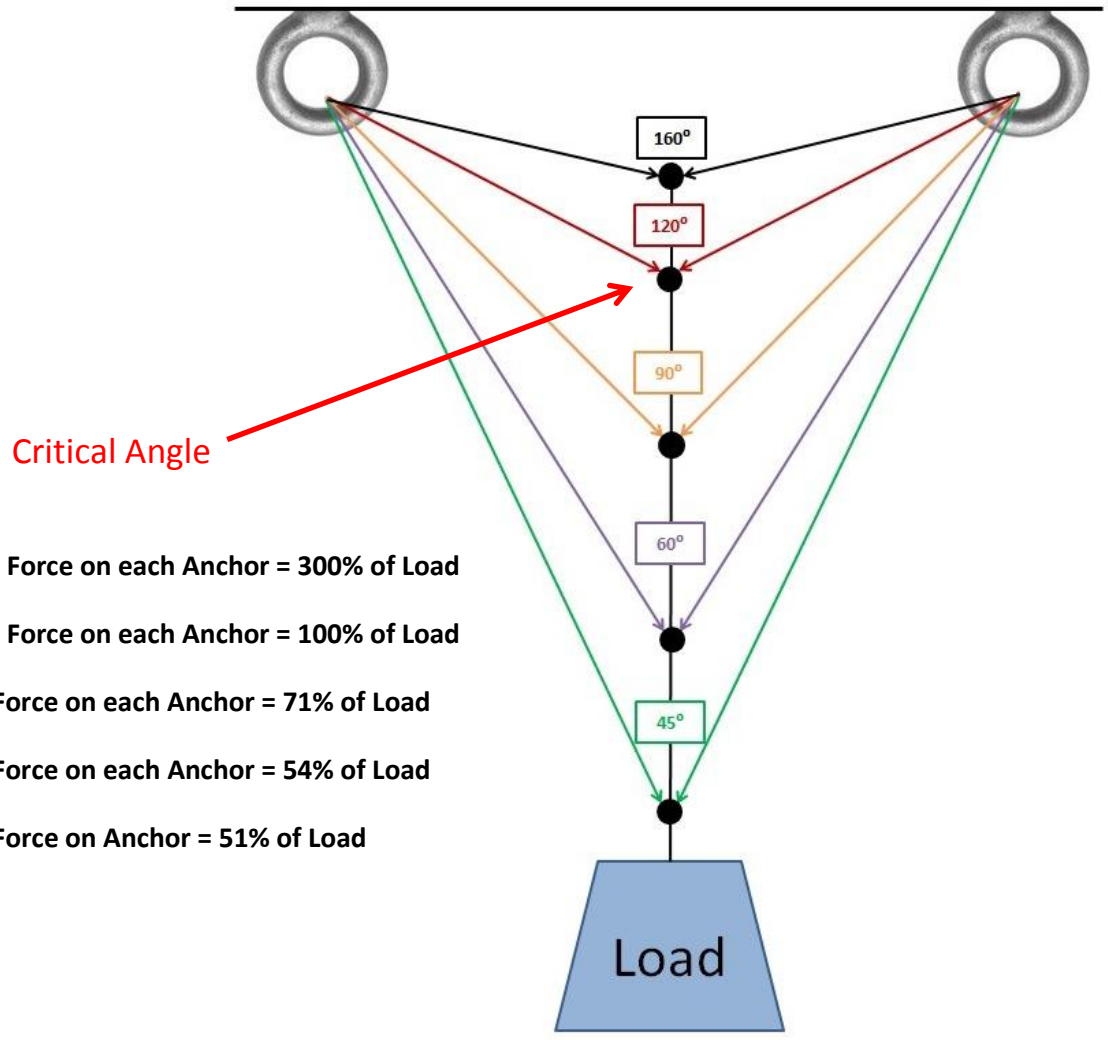
Pully Forces.

Resultant Force- *The combination of multiple vector forces acting on a body.*

Critical Angle- *The Included Angle where above which the load is putting more force on the anchor(s) than the weight of the load.*

Forces on Anchors

Any time a load is hanging directly under an anchor point, that anchor point is seeing 100% of the force in the vertical (single) direction. If you swing the load so that is not directly under the anchor point, you have now introduced a direction of pull in the horizontal axis as well. That anchor point will now be seeing even more than 100% of the force of the load. Not understanding vector forces and the angles that you are using them can be a fatal mistake when lifting loads overhead or performing a rescue.



160°- Force on each Anchor = 300% of Load

120°- Force on each Anchor = 100% of Load

90°- Force on each Anchor = 71% of Load

60°- Force on each Anchor = 54% of Load

45°- Force on Anchor = 51% of Load

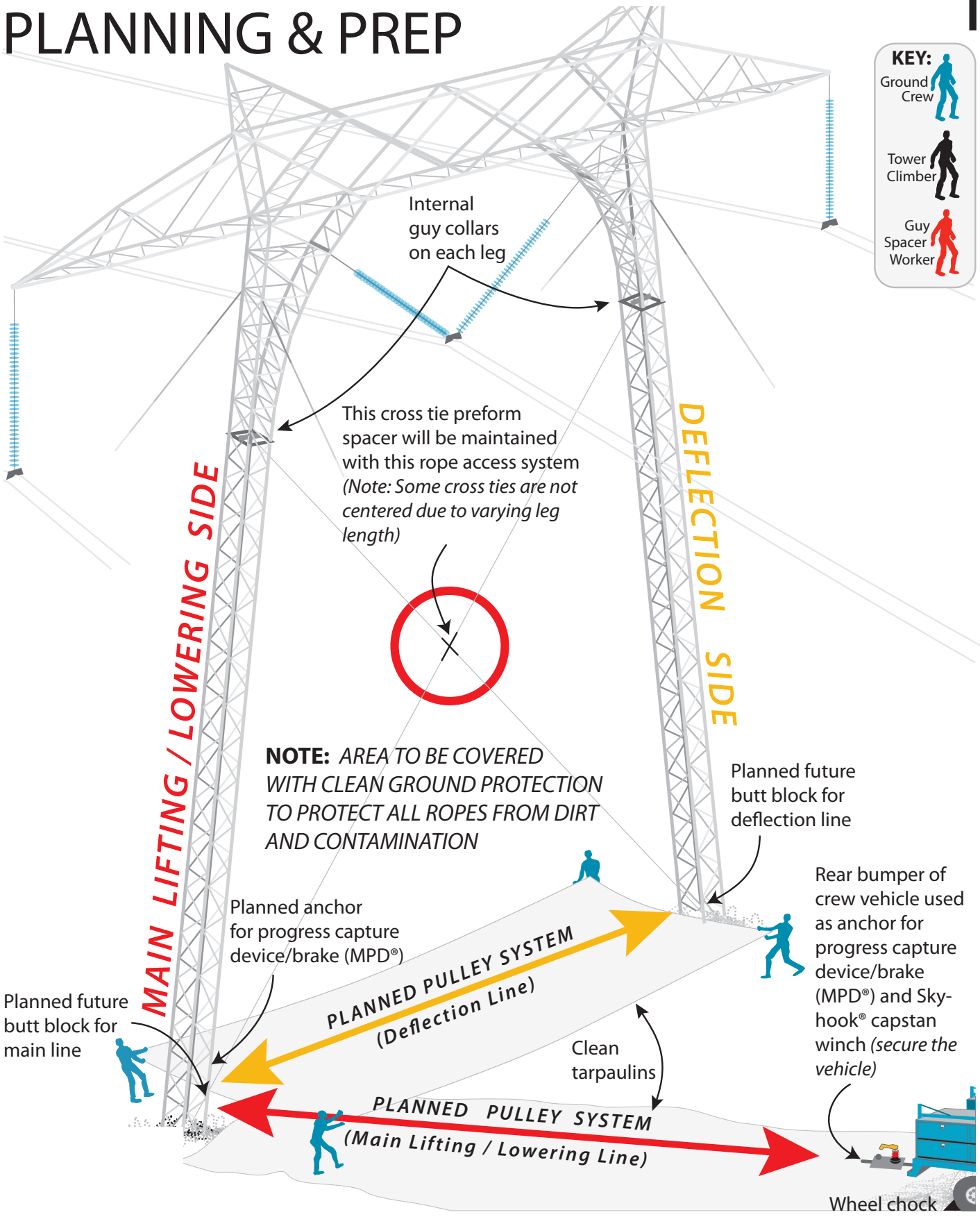
2.2 PROCEDURE ILLUSTRATIONS

2.2.A HVA CROSS TIE PRE-FORM MAINTENANCE

HVA cross tie pre-form maintenance:

PLANNING & PREP

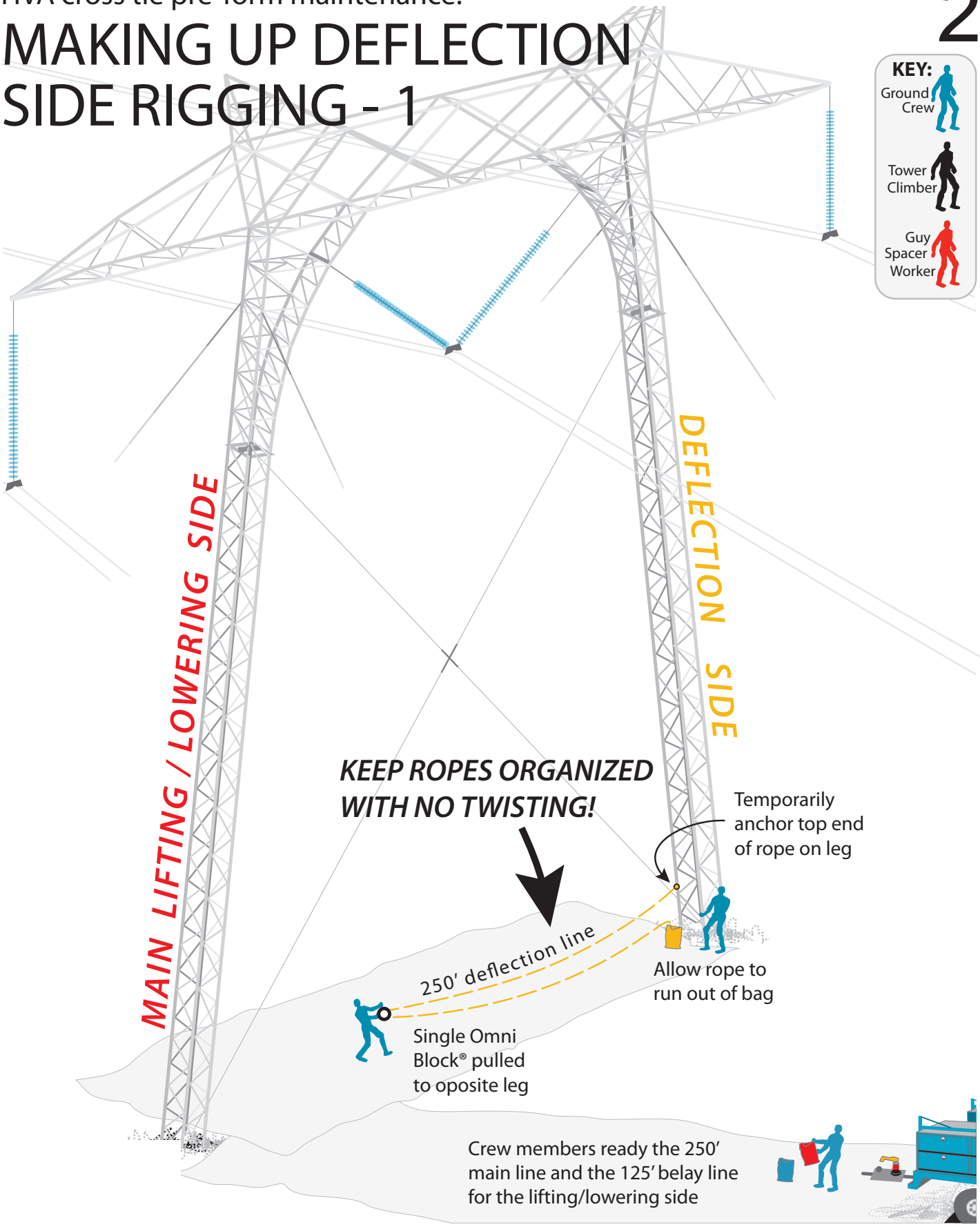
1



HVA cross tie pre-form maintenance:

MAKING UP DEFLECTION SIDE RIGGING - 1

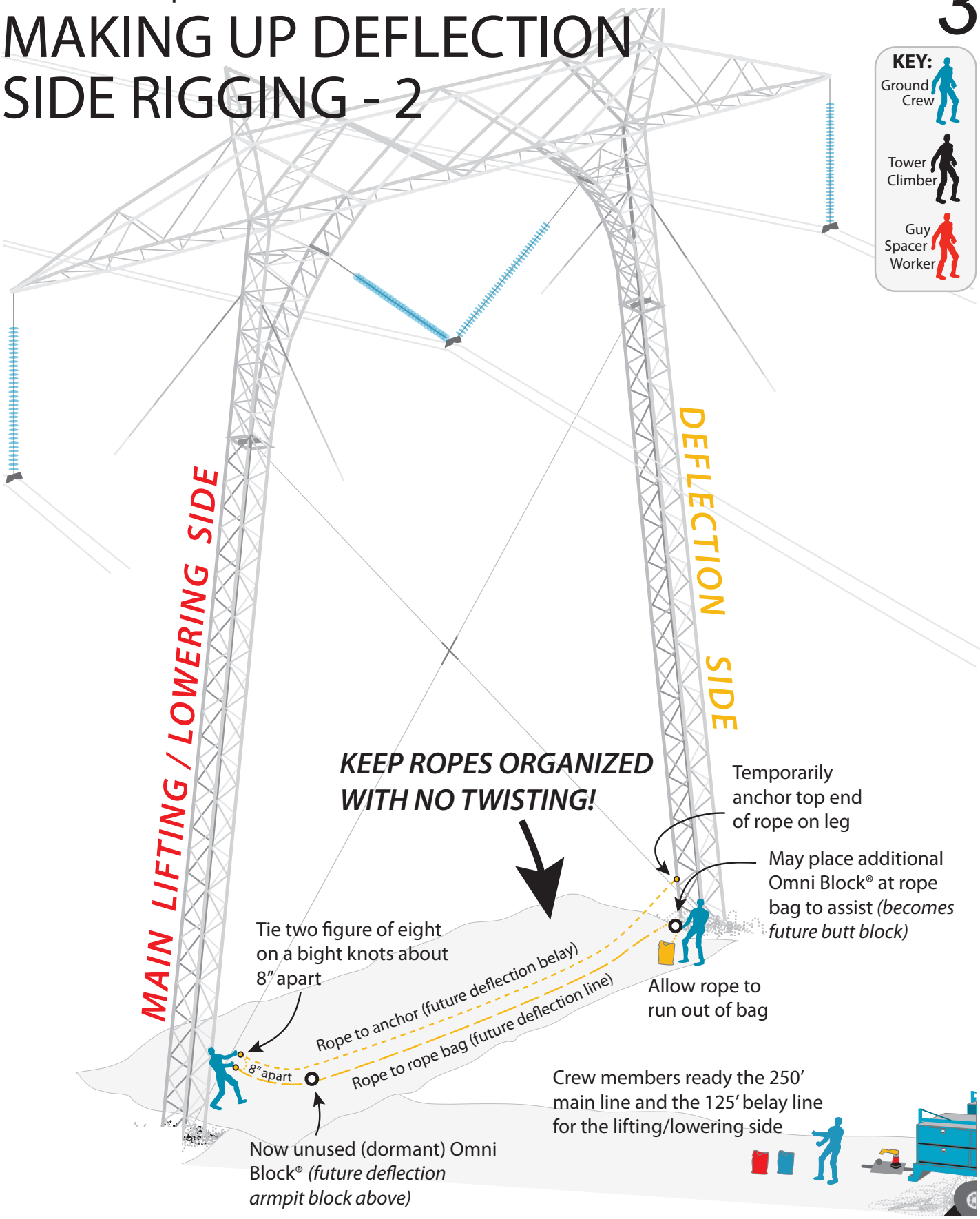
2



HVA cross tie pre-form maintenance:

MAKING UP DEFLECTION SIDE RIGGING - 2

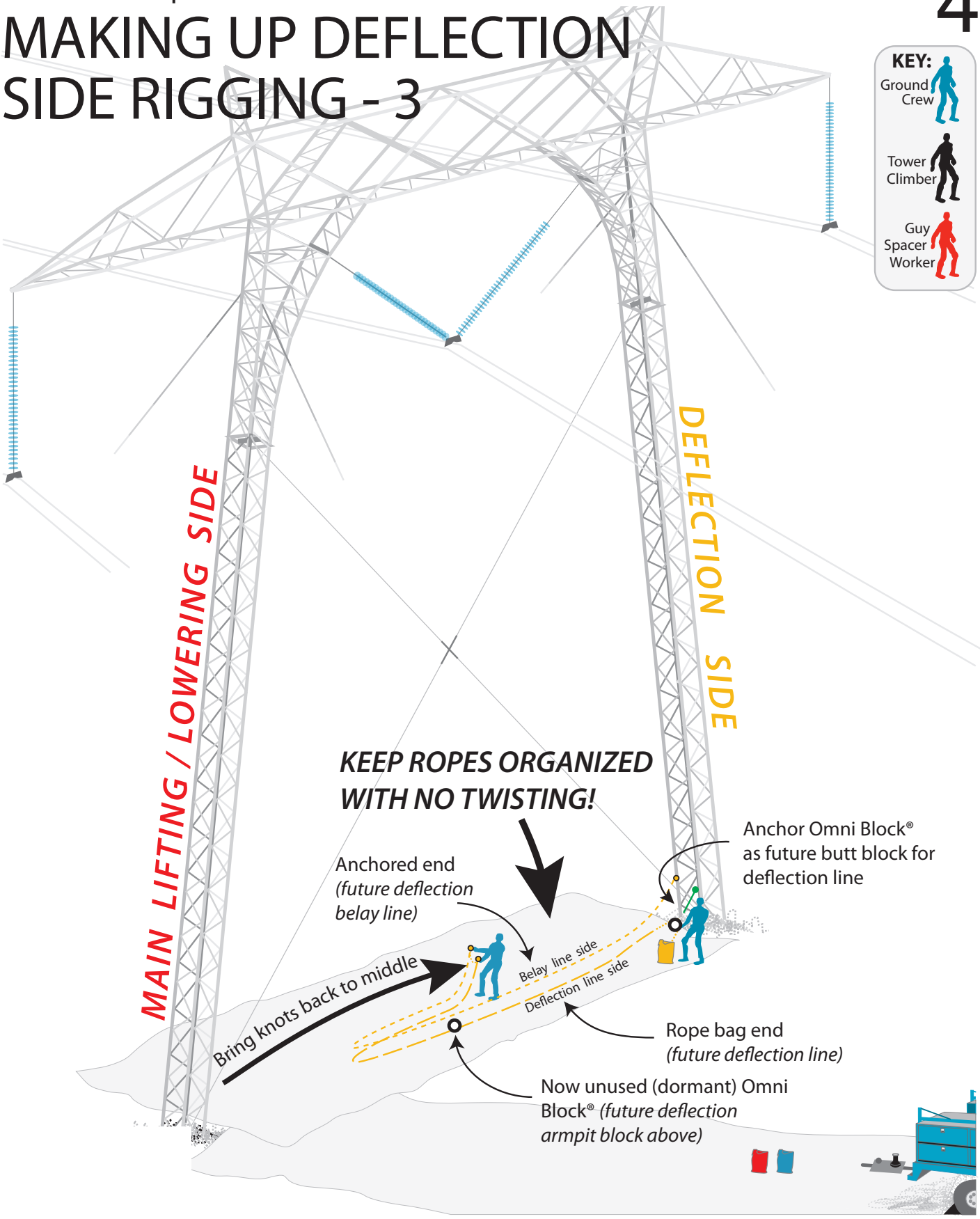
3



HVA cross tie pre-form maintenance:

MAKING UP DEFLECTION SIDE RIGGING - 3

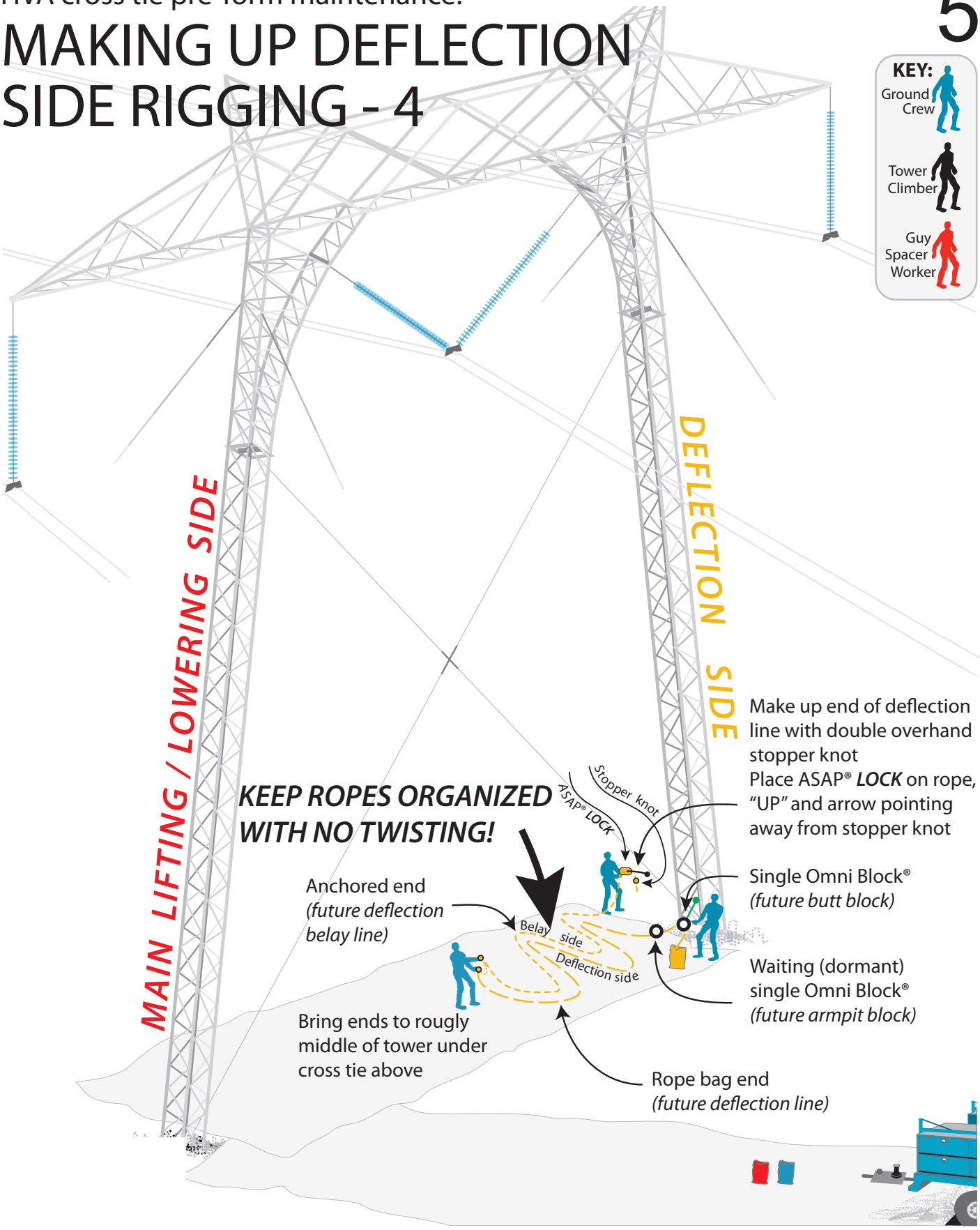
4



HVA cross tie pre-form maintenance:

MAKING UP DEFLECTION SIDE RIGGING - 4

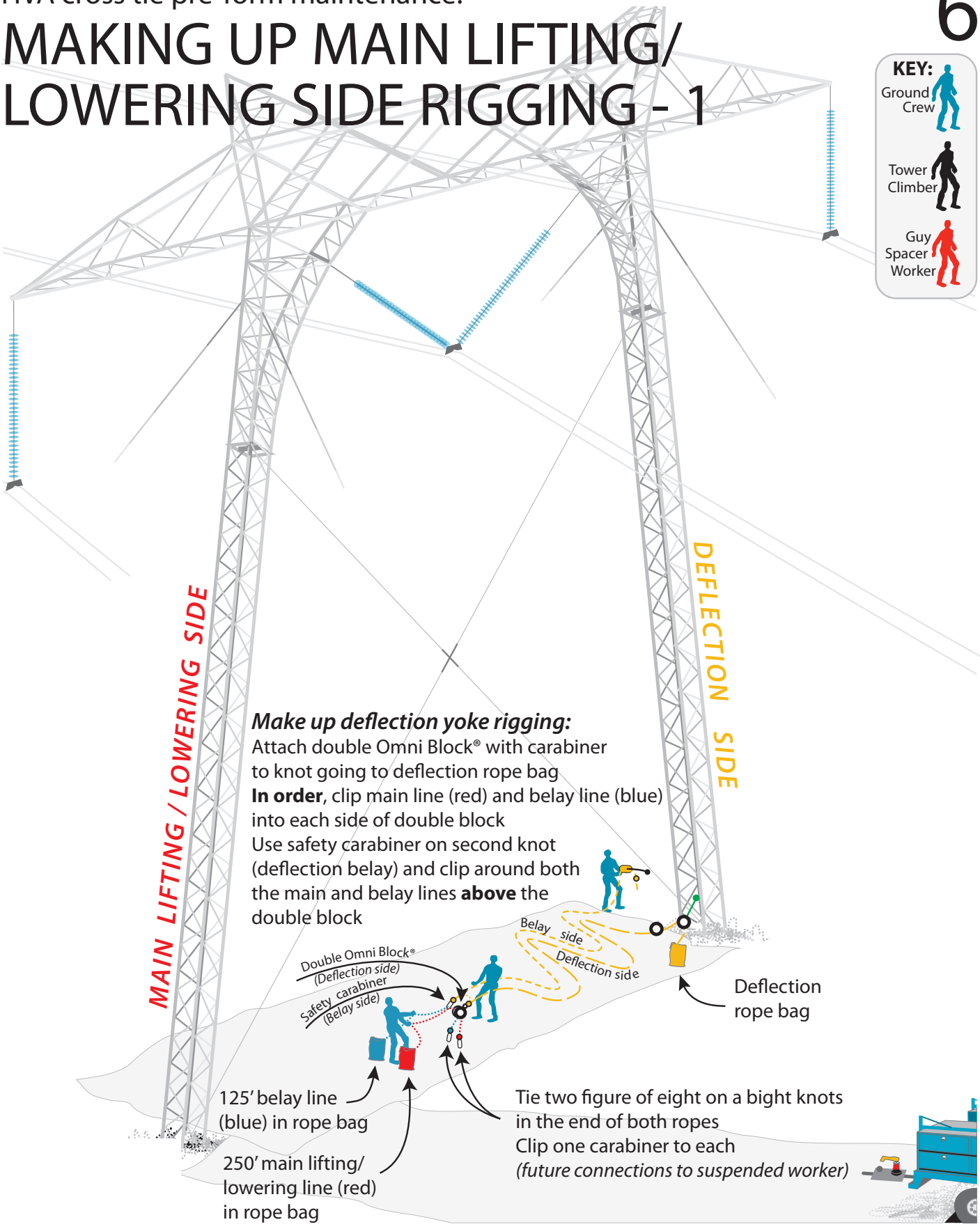
5



HVA cross tie pre-form maintenance:

MAKING UP MAIN LIFTING/ LOWERING SIDE RIGGING - 1

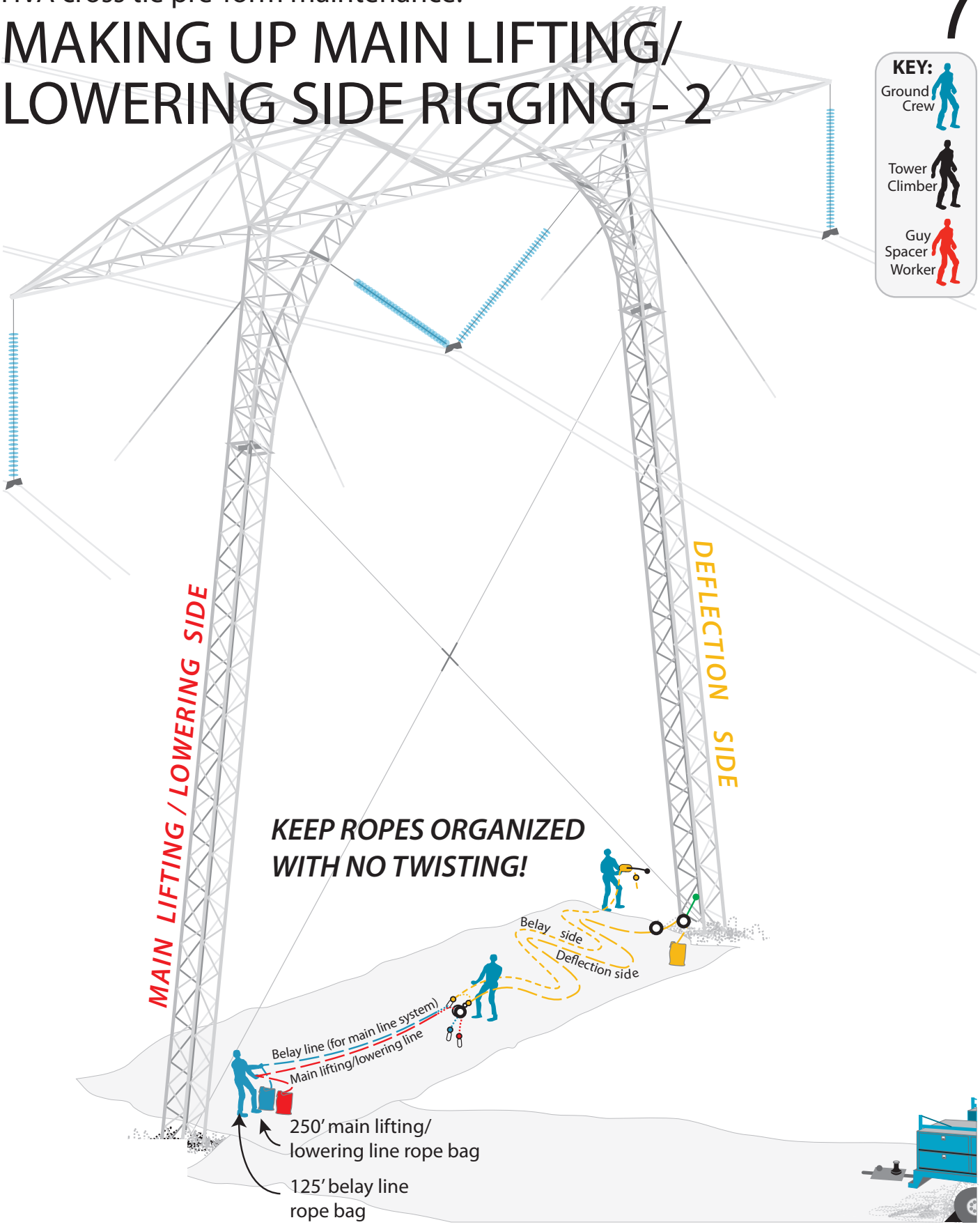
6



HVA cross tie pre-form maintenance:

MAKING UP MAIN LIFTING/ LOWERING SIDE RIGGING - 2

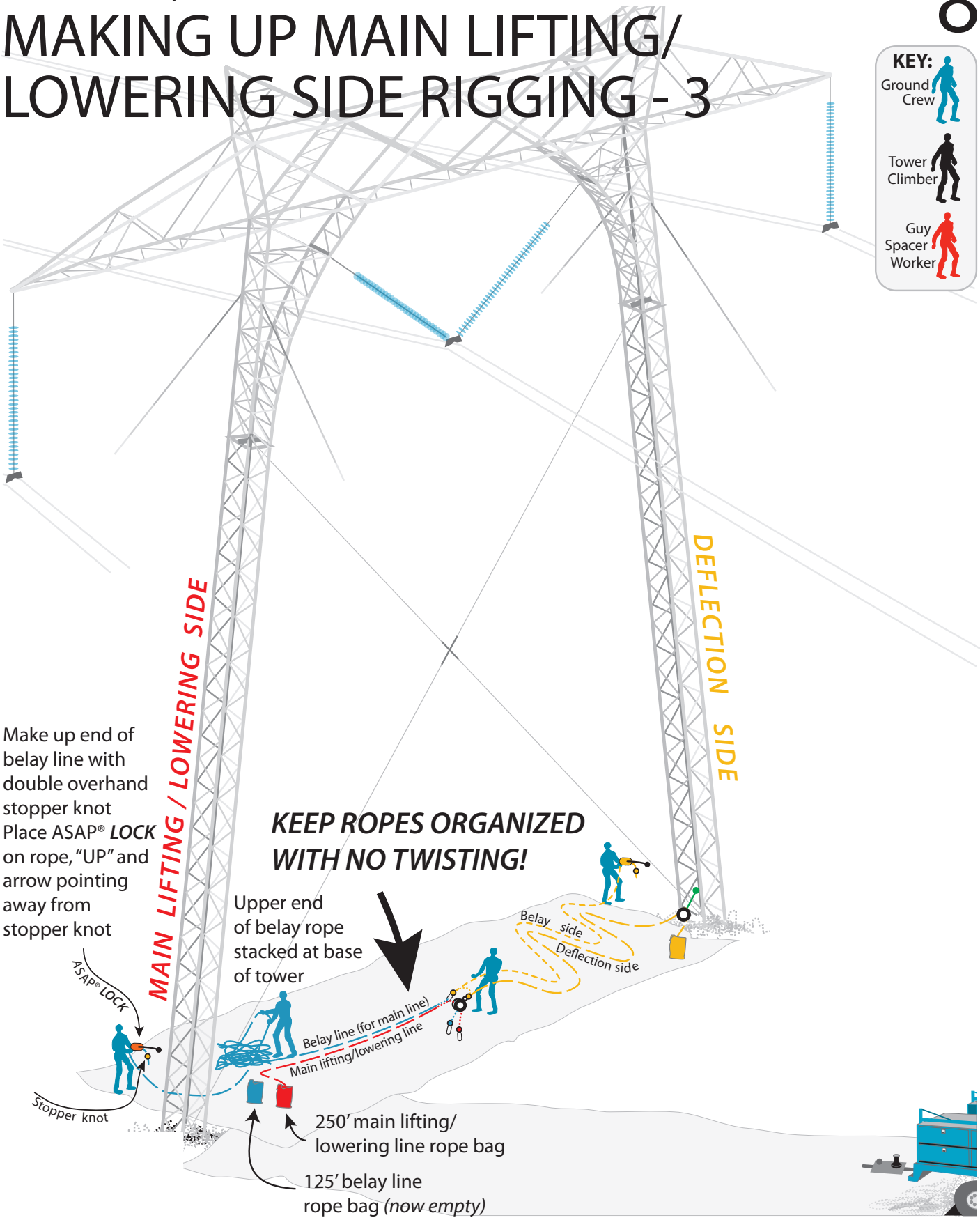
7



HVA cross tie pre-form maintenance:

MAKING UP MAIN LIFTING/ LOWERING SIDE RIGGING - 3

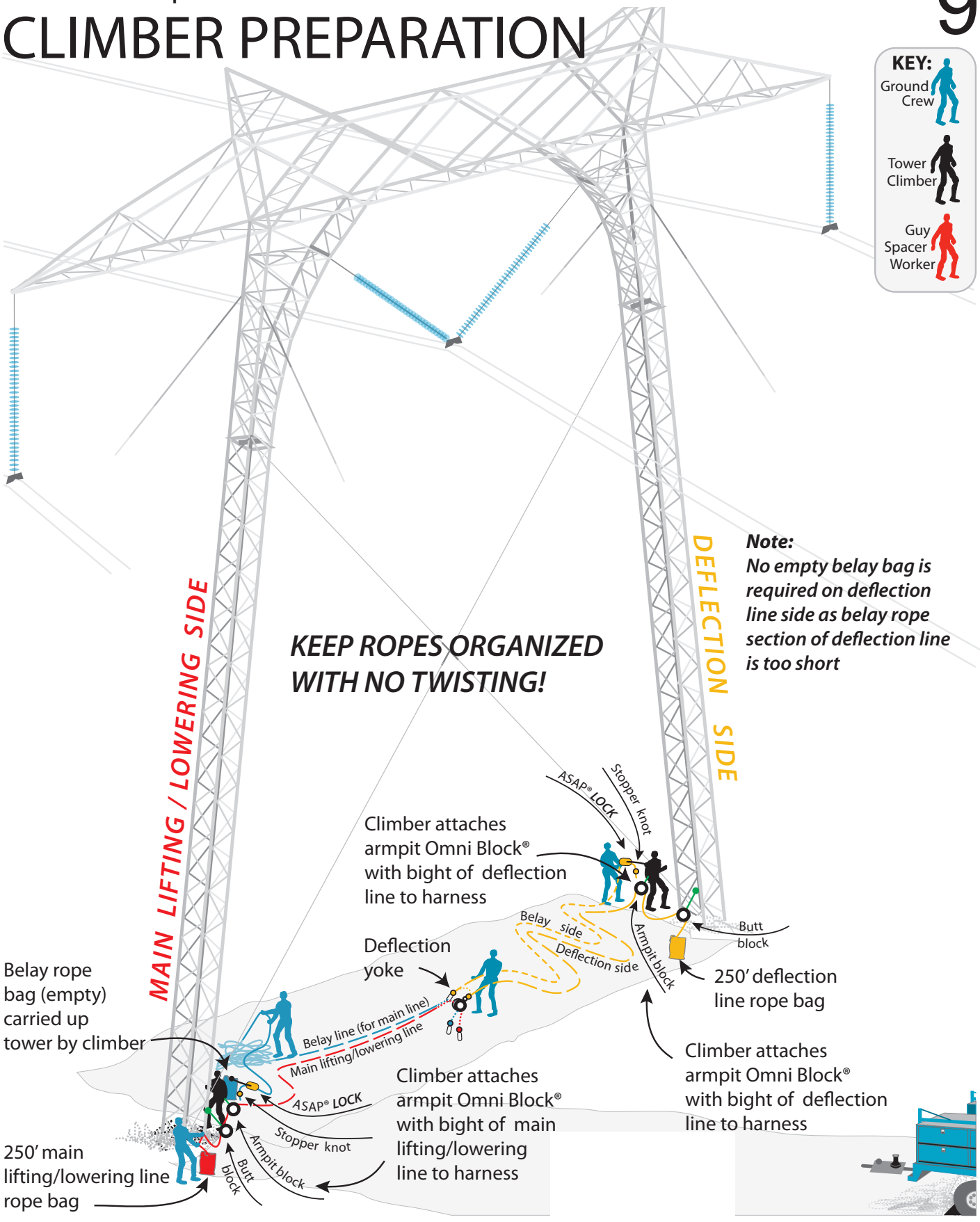
8



HVA cross tie pre-form maintenance:

CLIMBER PREPARATION

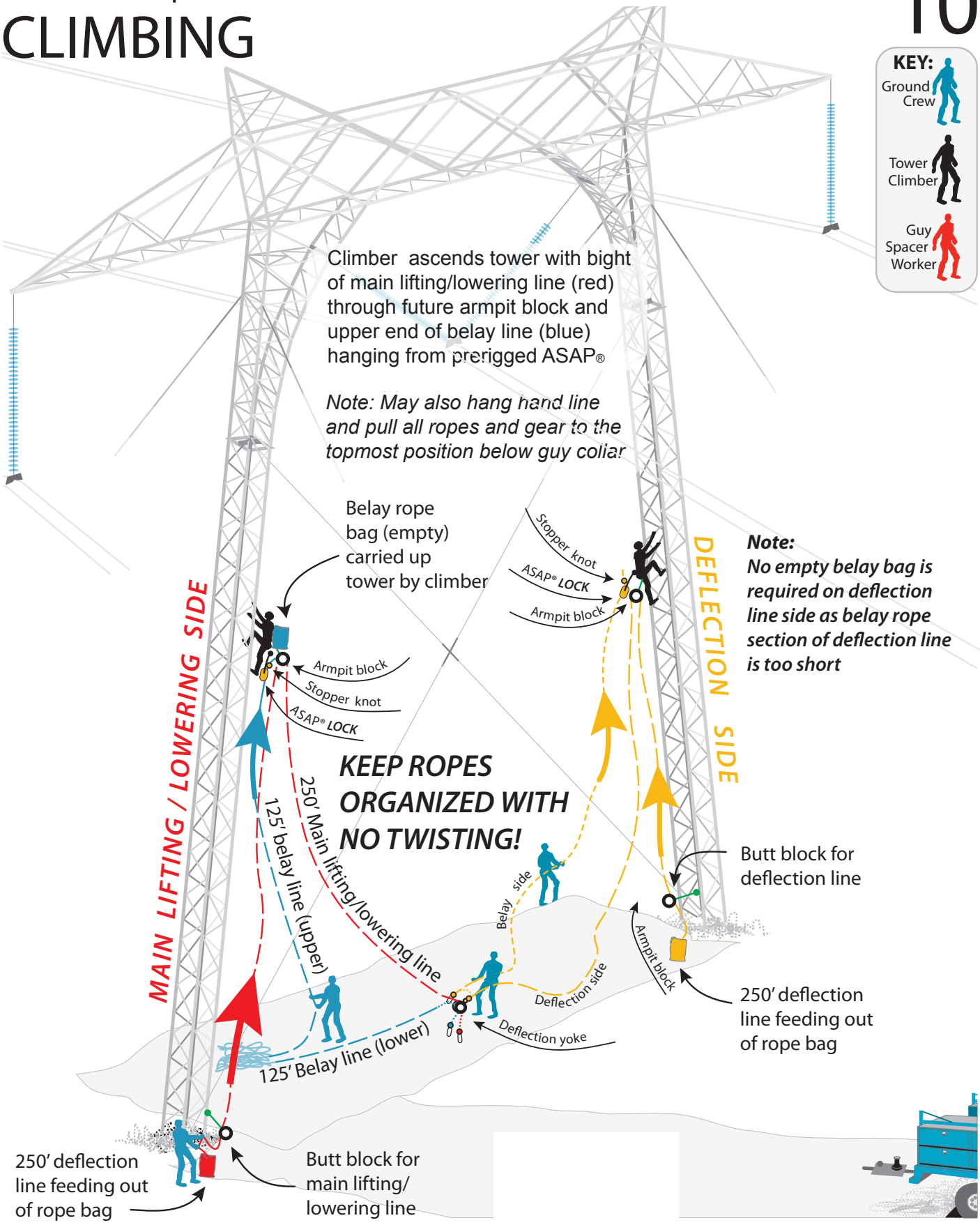
9



HVA cross tie pre-form maintenance:

CLIMBING

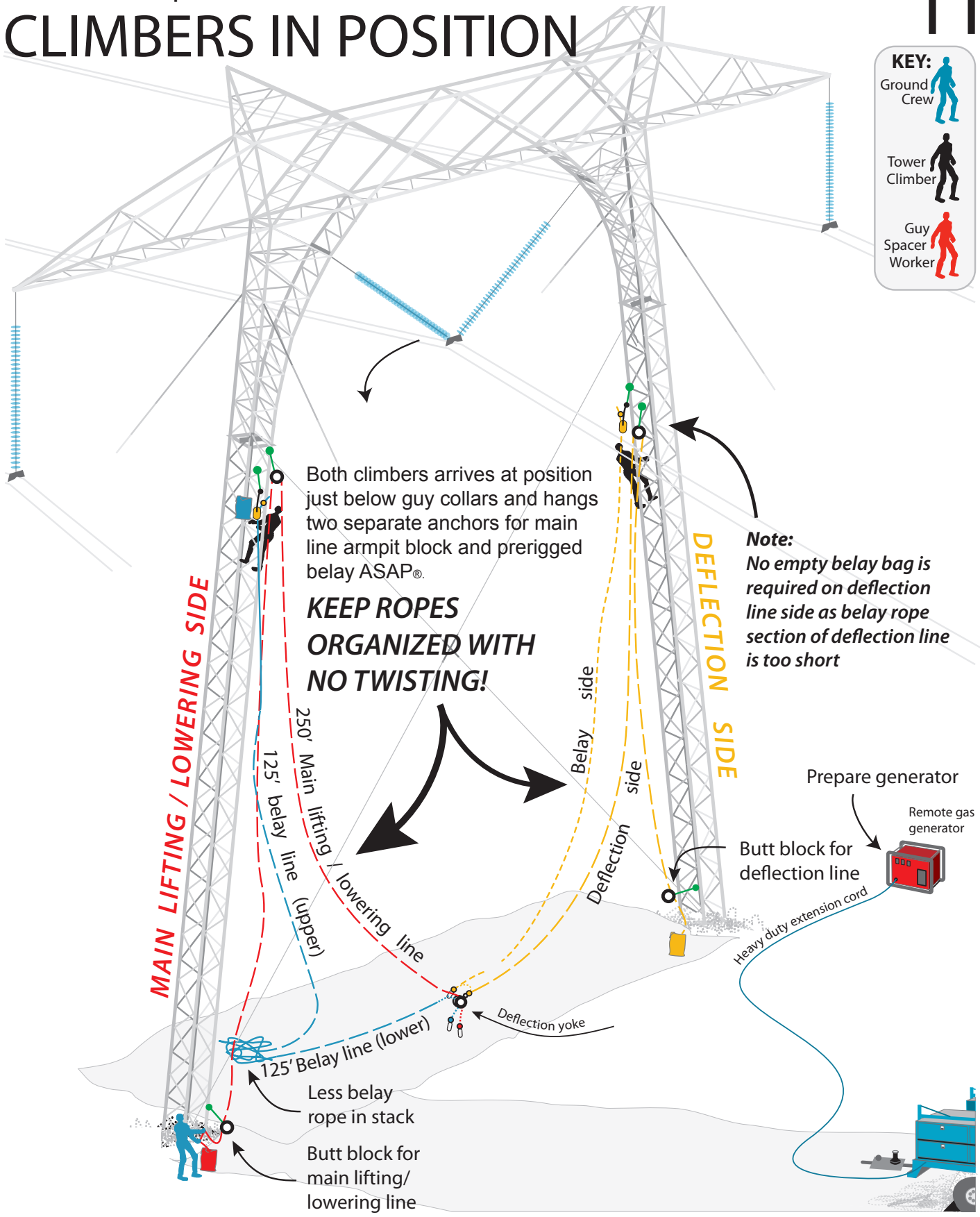
10



HVA cross tie pre-form maintenance:

CLIMBERS IN POSITION

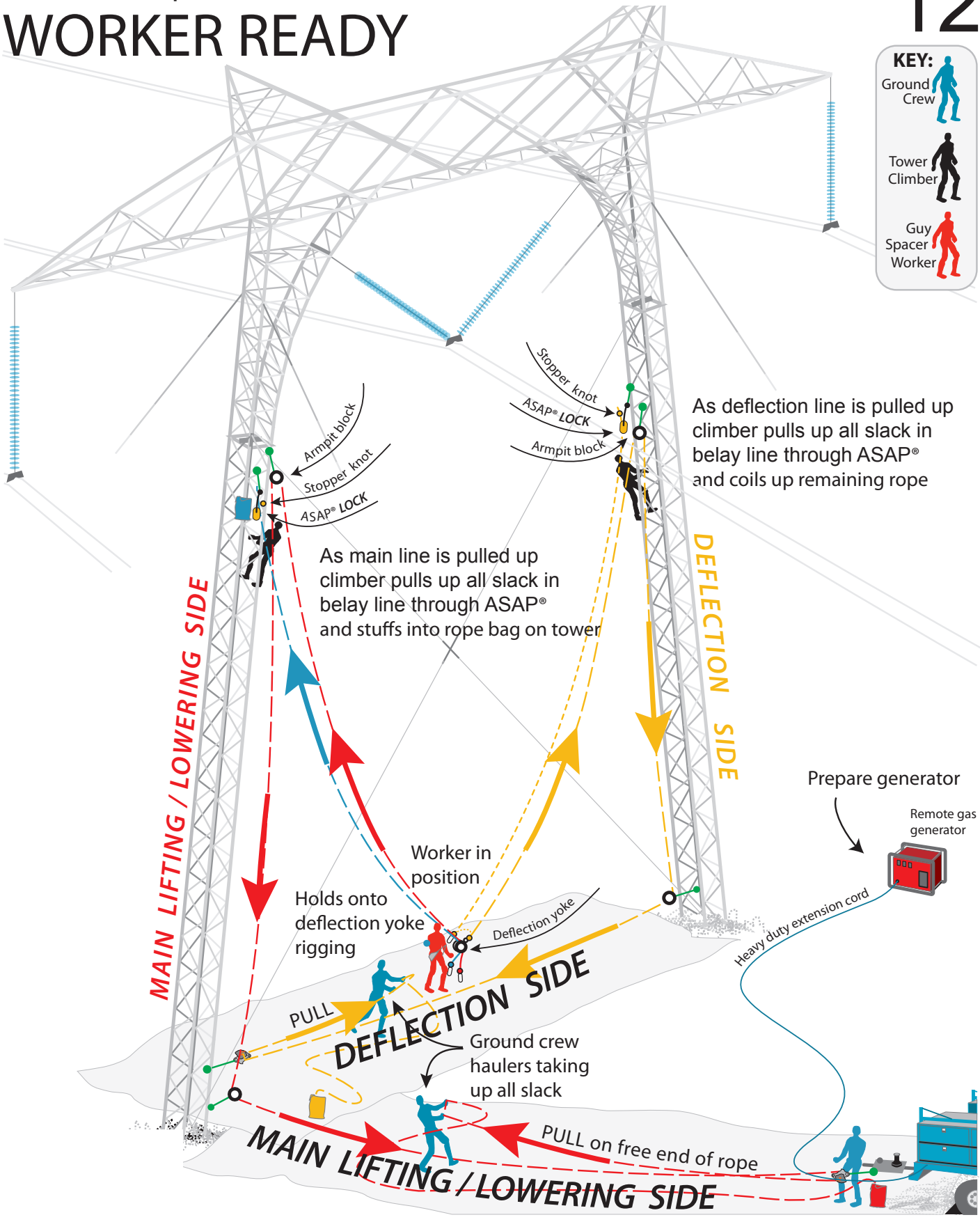
11



HVA cross tie pre-form maintenance:

WORKER READY

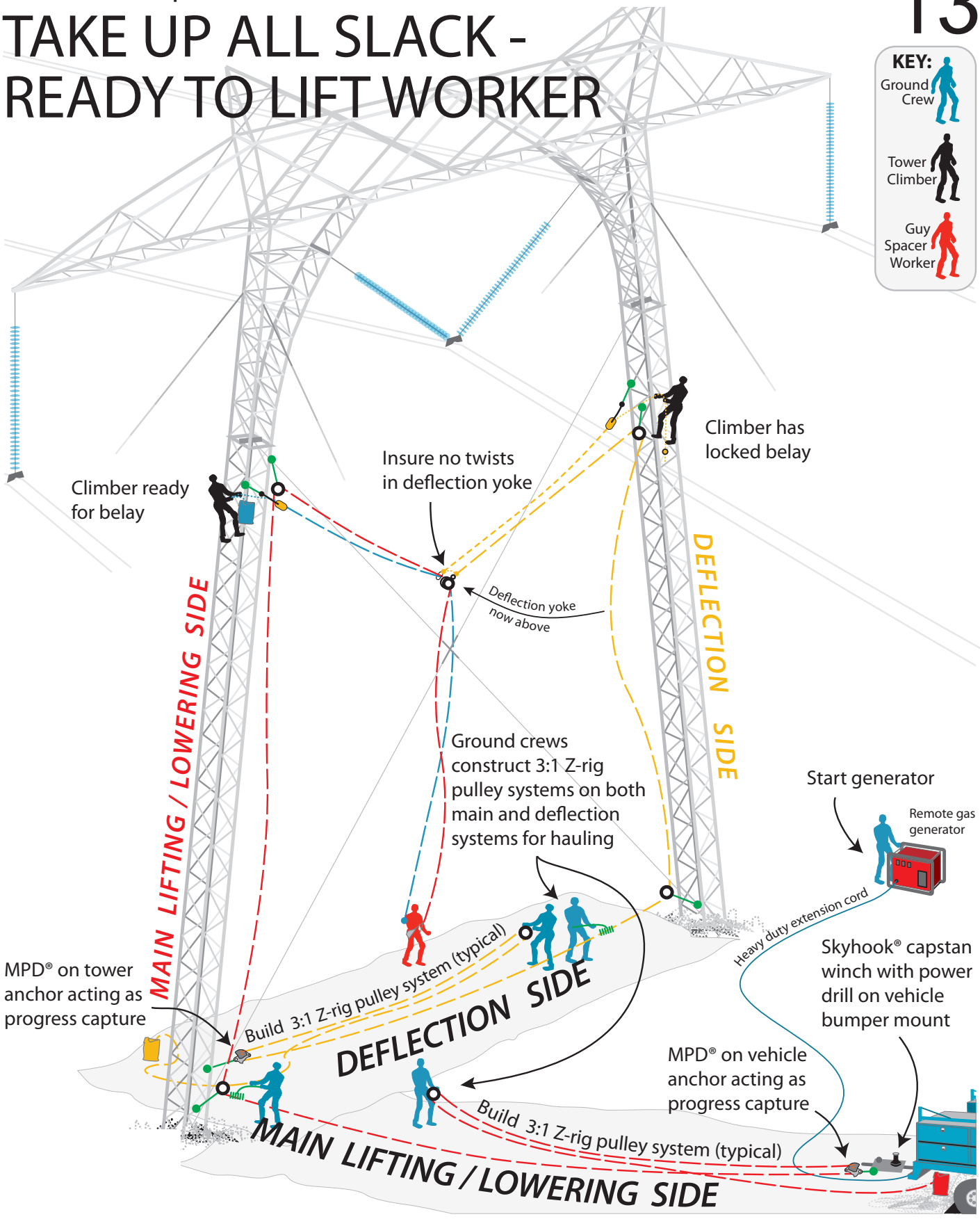
12



HVA cross tie pre-form maintenance:

TAKE UP ALL SLACK - READY TO LIFT WORKER

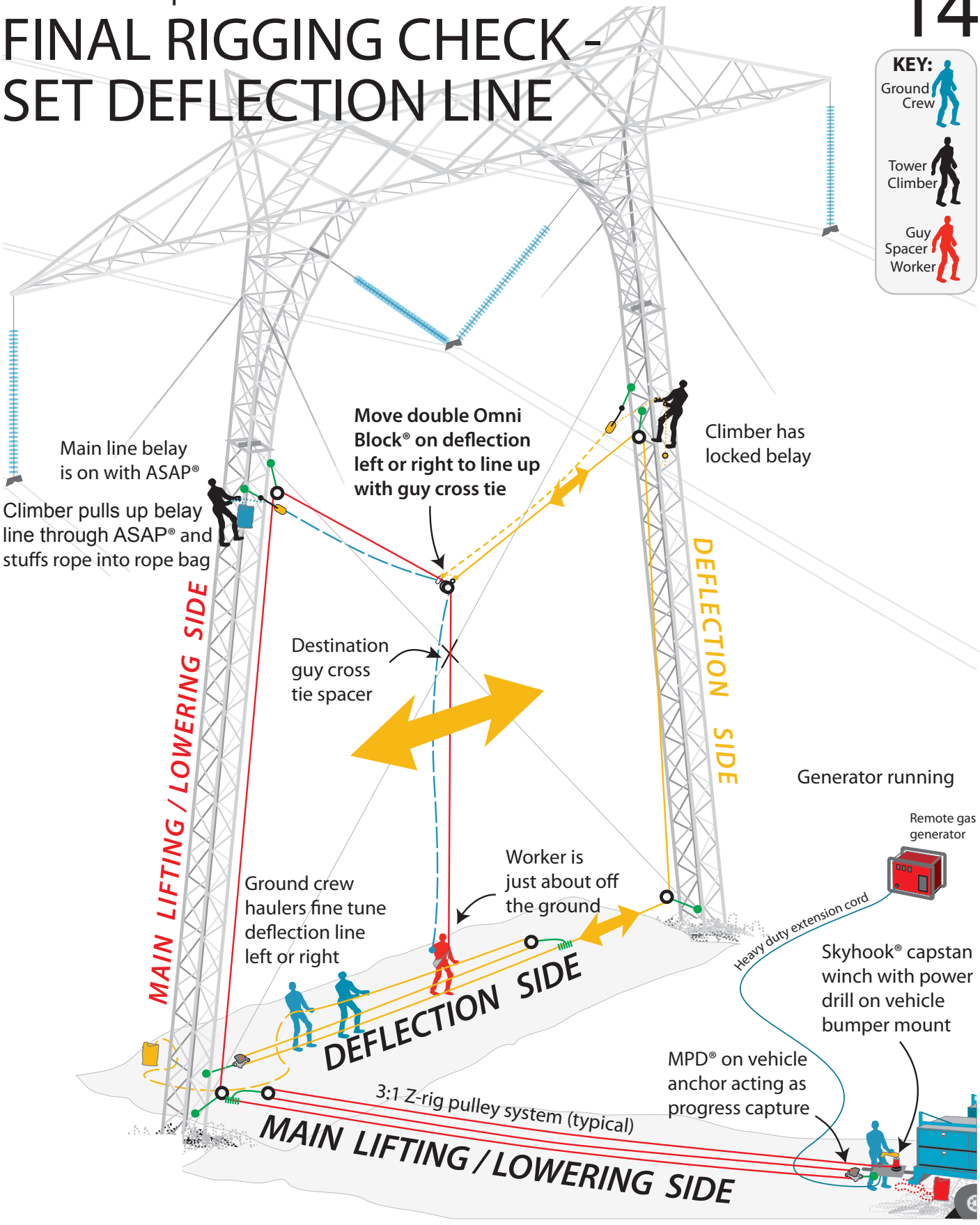
13



HVA cross tie pre-form maintenance:

FINAL RIGGING CHECK - SET DEFLECTION LINE

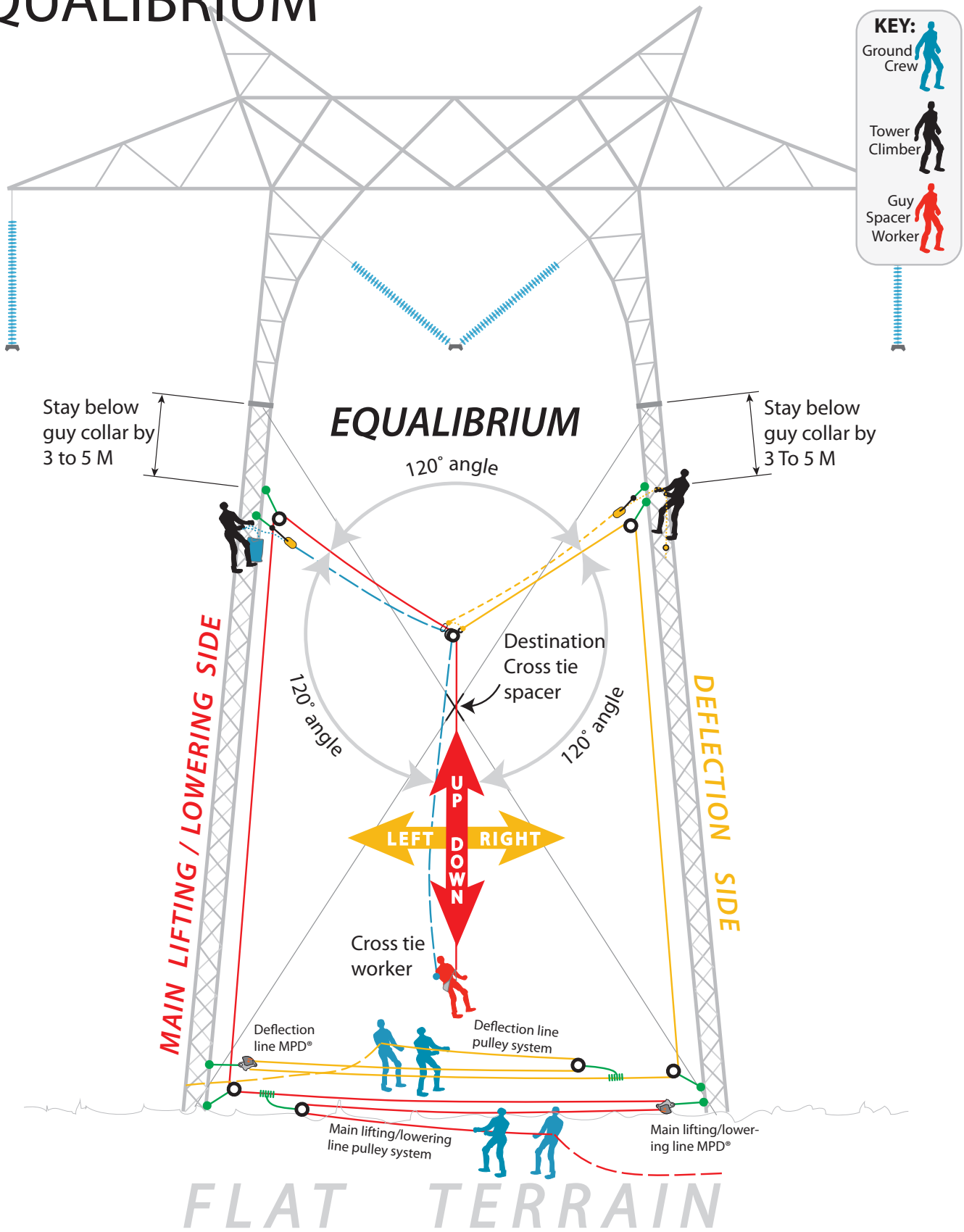
14



HVA cross tie pre-form maintenance:

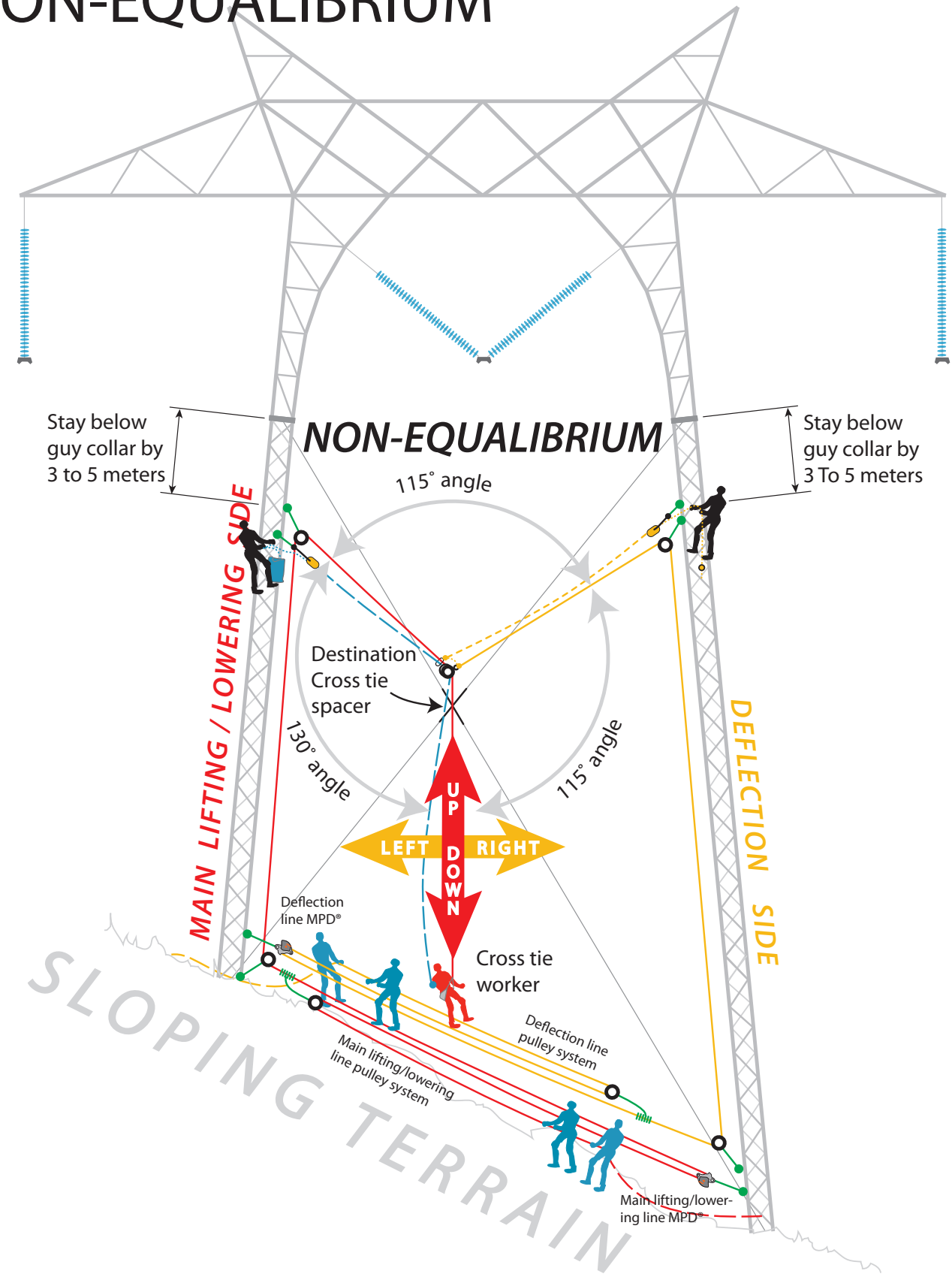
EQUALIBRIUM

14



HVA cross tie pre-form maintenance:

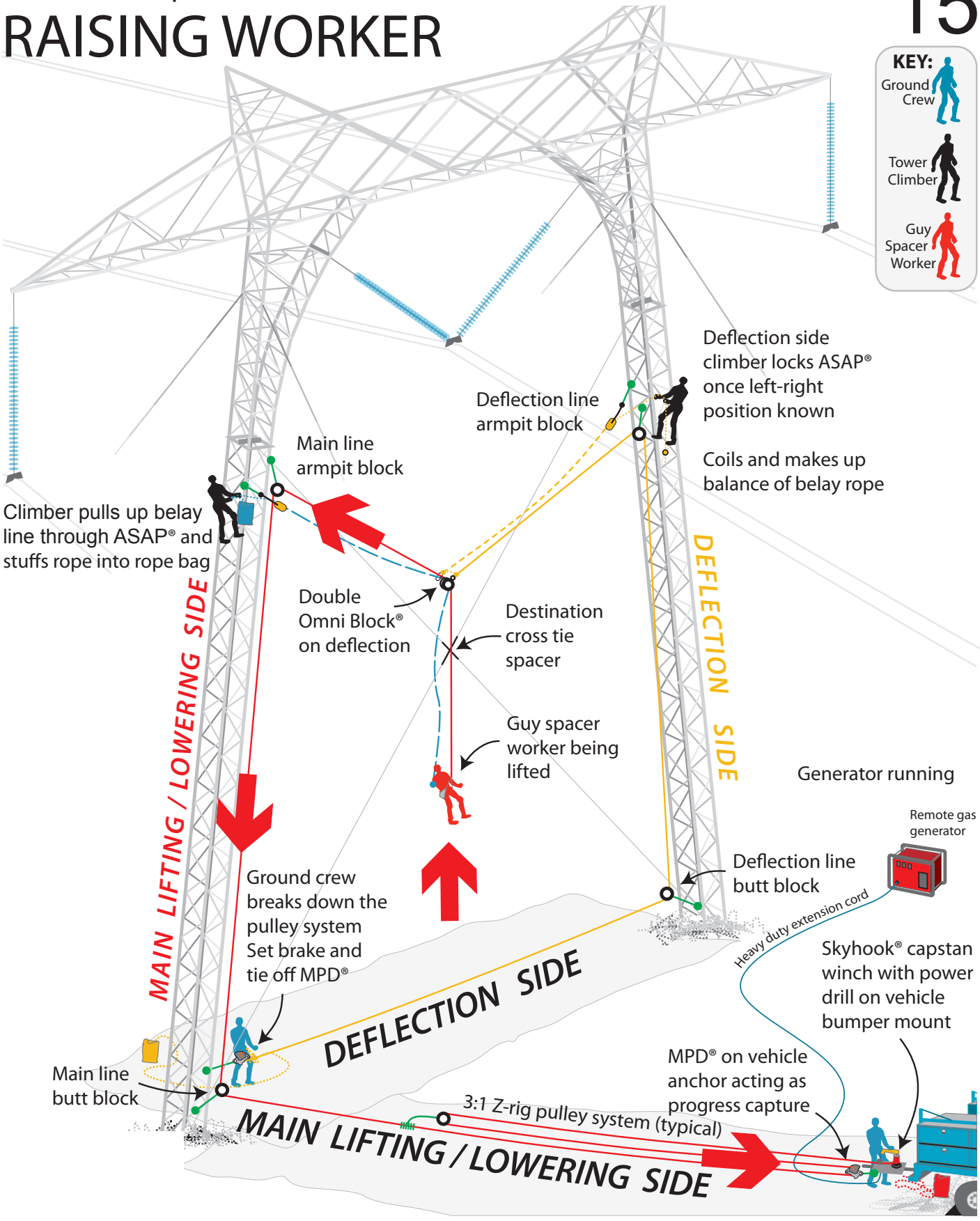
NON-EQUALIBRIUM



HVA cross tie pre-form maintenance:

RAISING WORKER

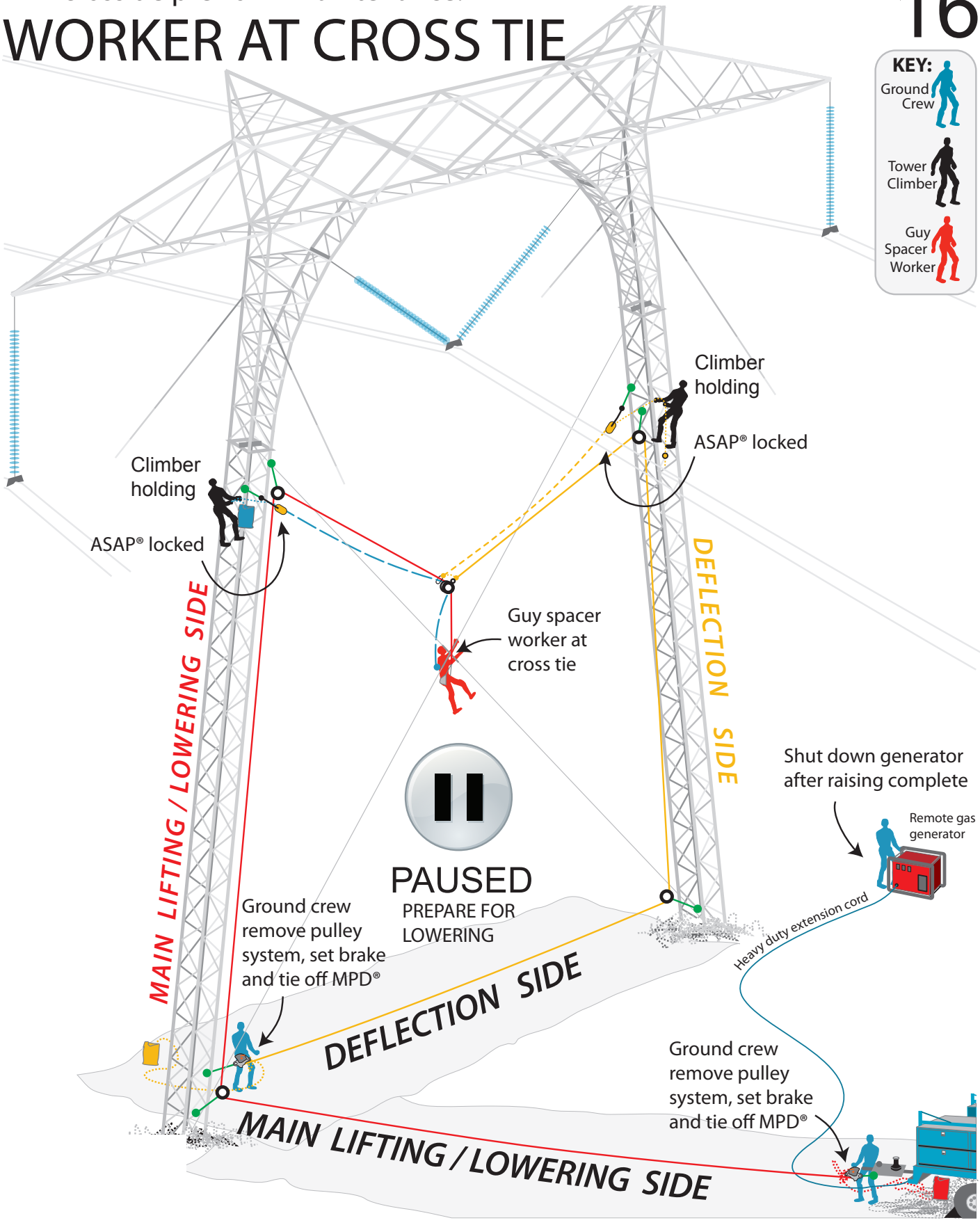
15



HVA cross tie pre-form maintenance:

WORKER AT CROSS TIE

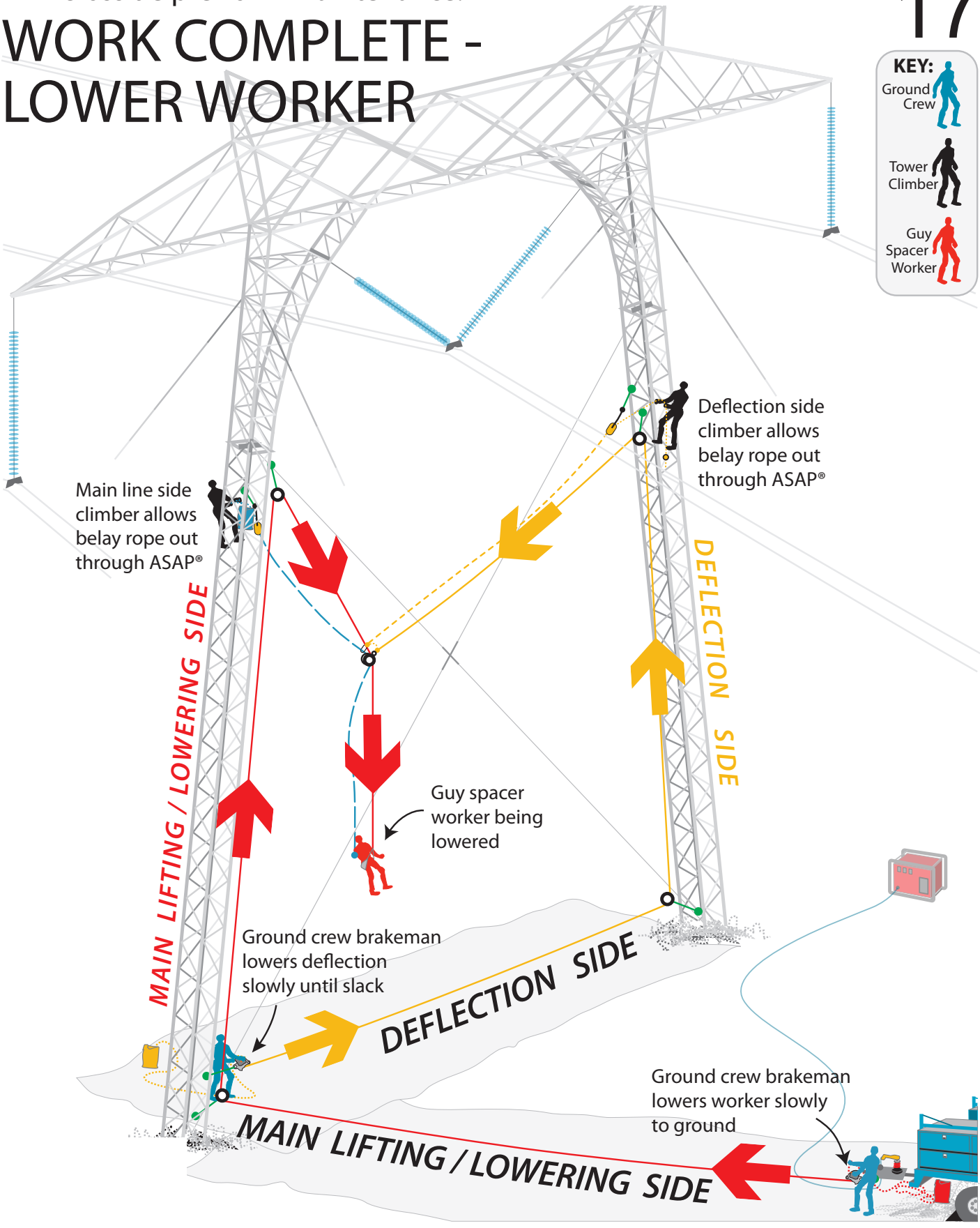
16



HVA cross tie pre-form maintenance:

WORK COMPLETE - LOWER WORKER

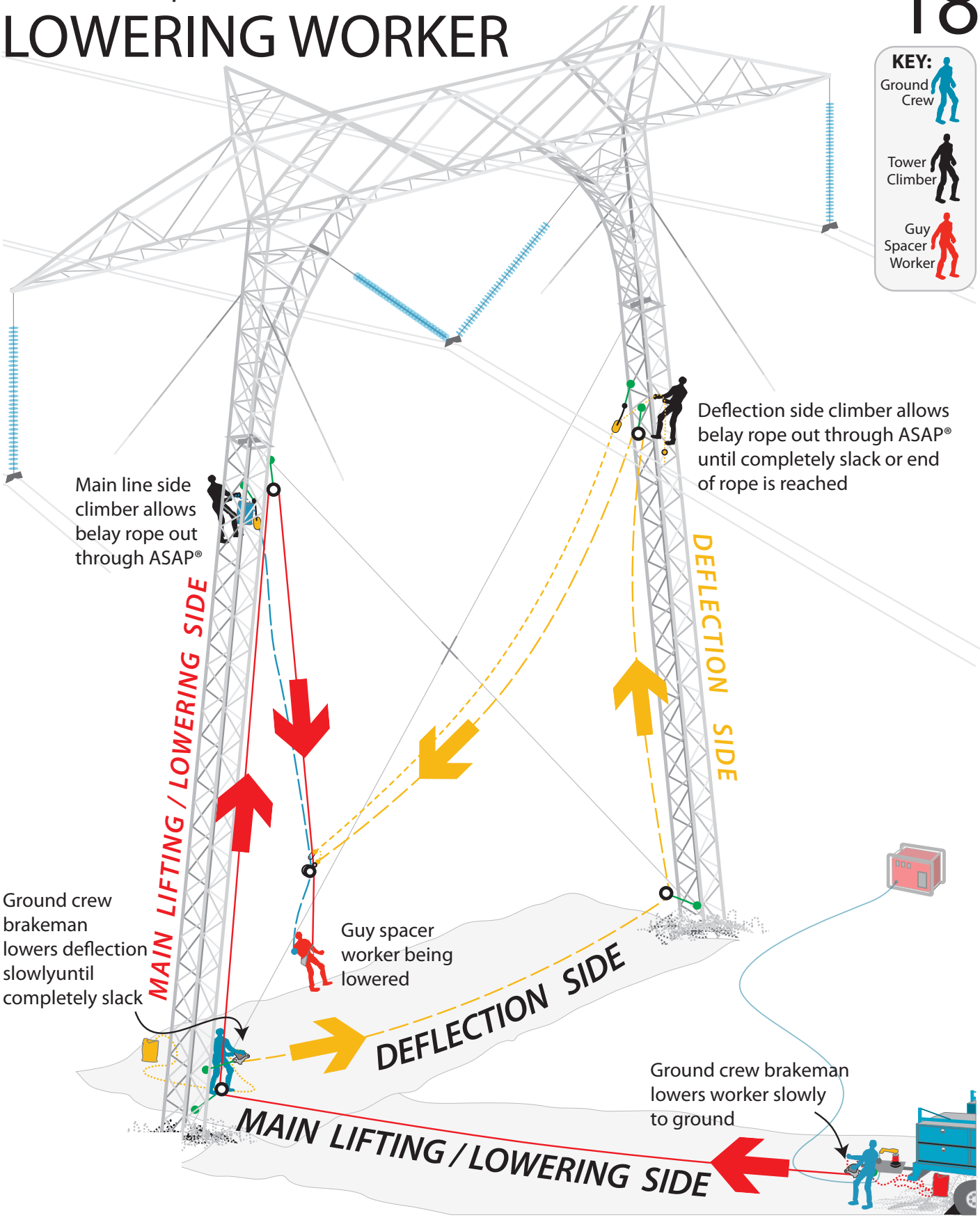
17



HVA cross tie pre-form maintenance:

LOWERING WORKER

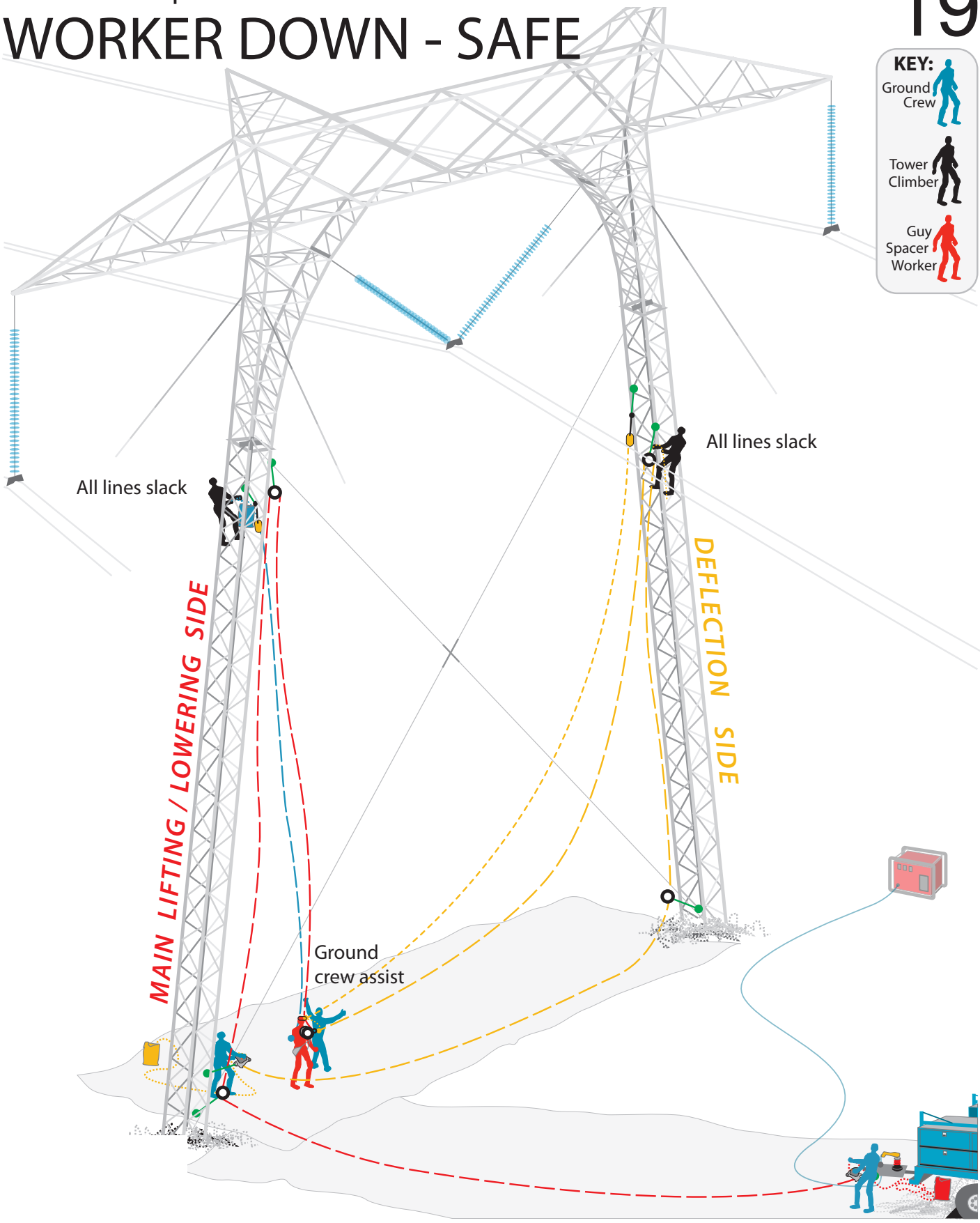
18



HVA cross tie pre-form maintenance:

WORKER DOWN - SAFE

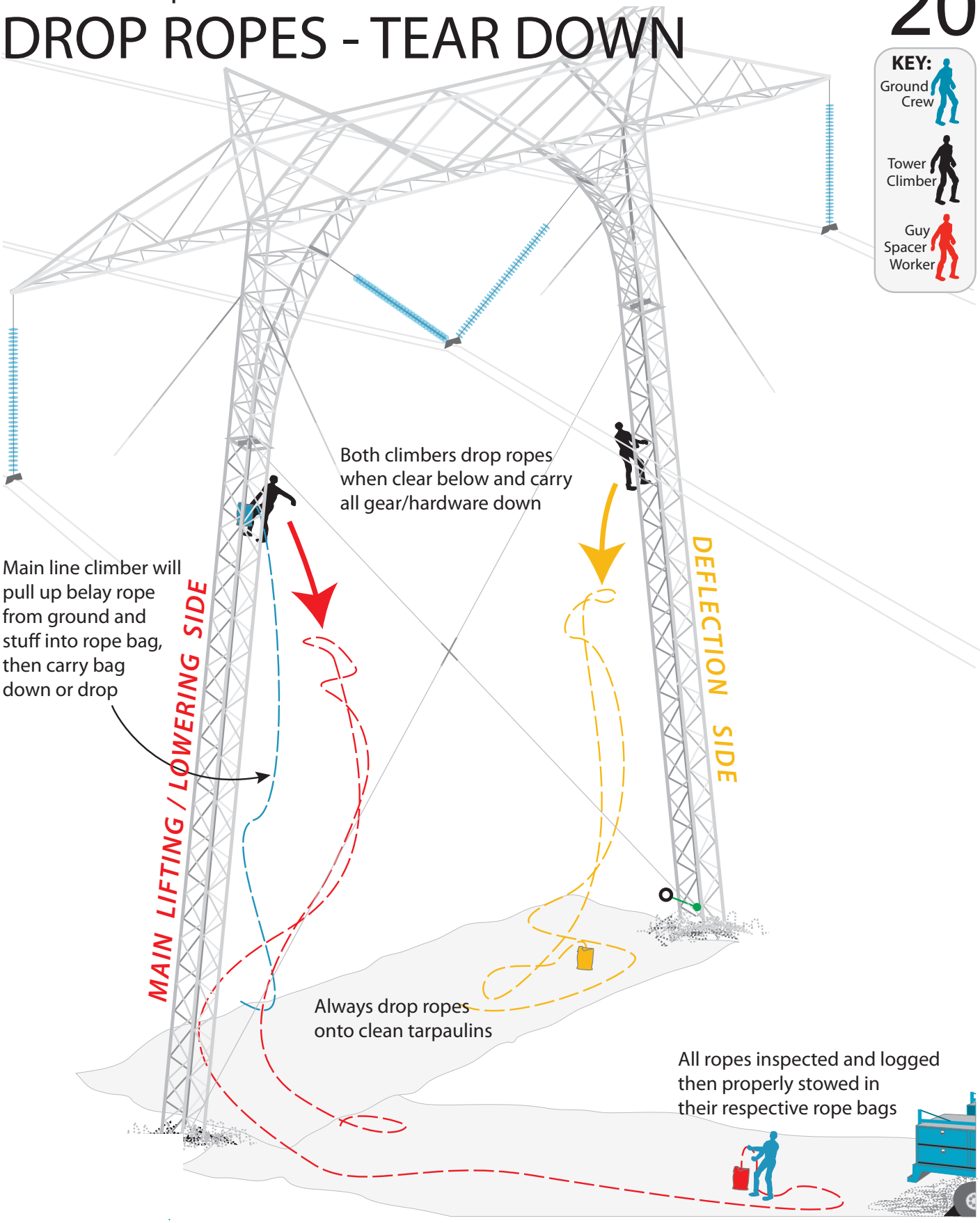
19



HVA cross tie pre-form maintenance:

DROP ROPES - TEAR DOWN

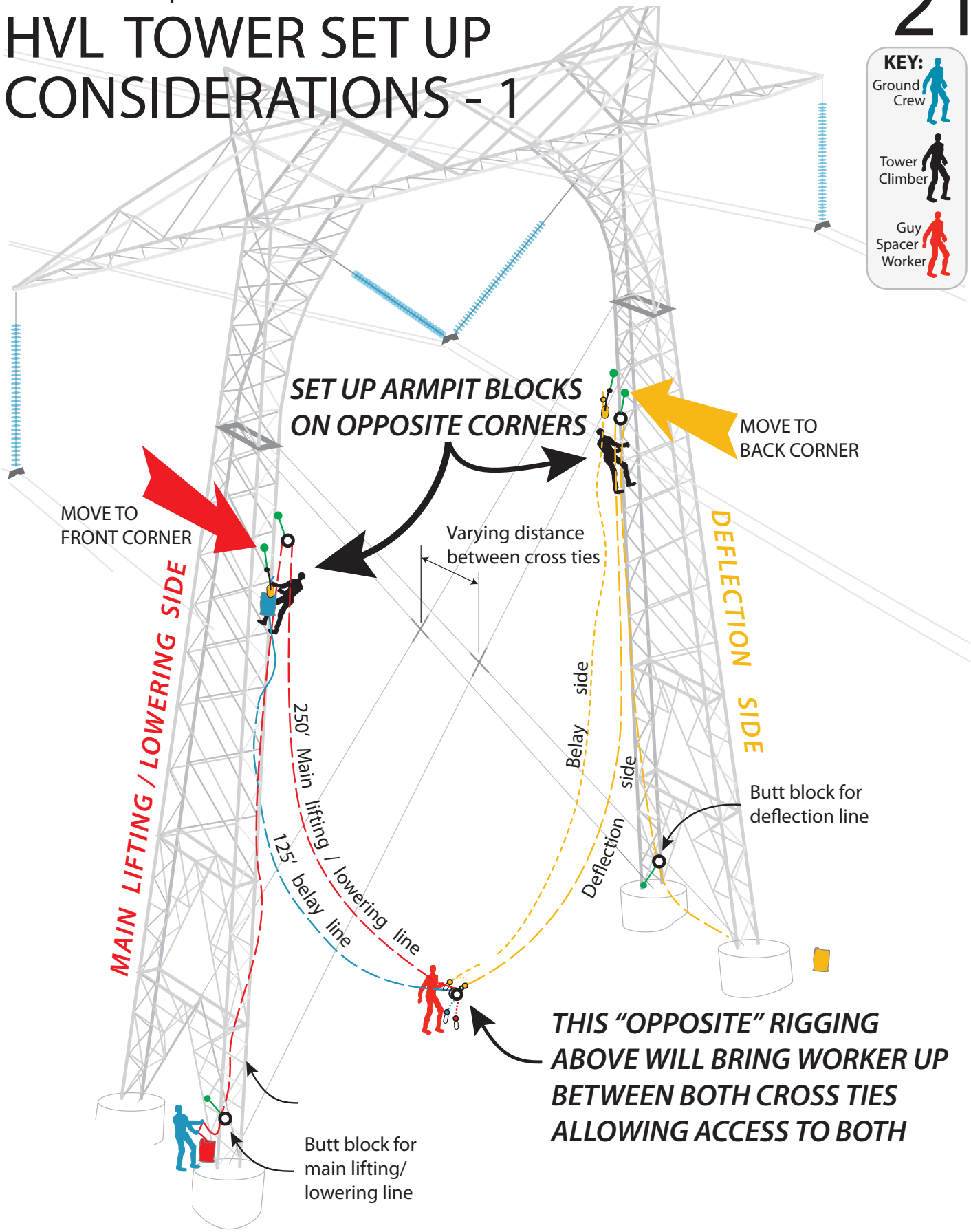
20



HVL cross tie pre-form maintenance:

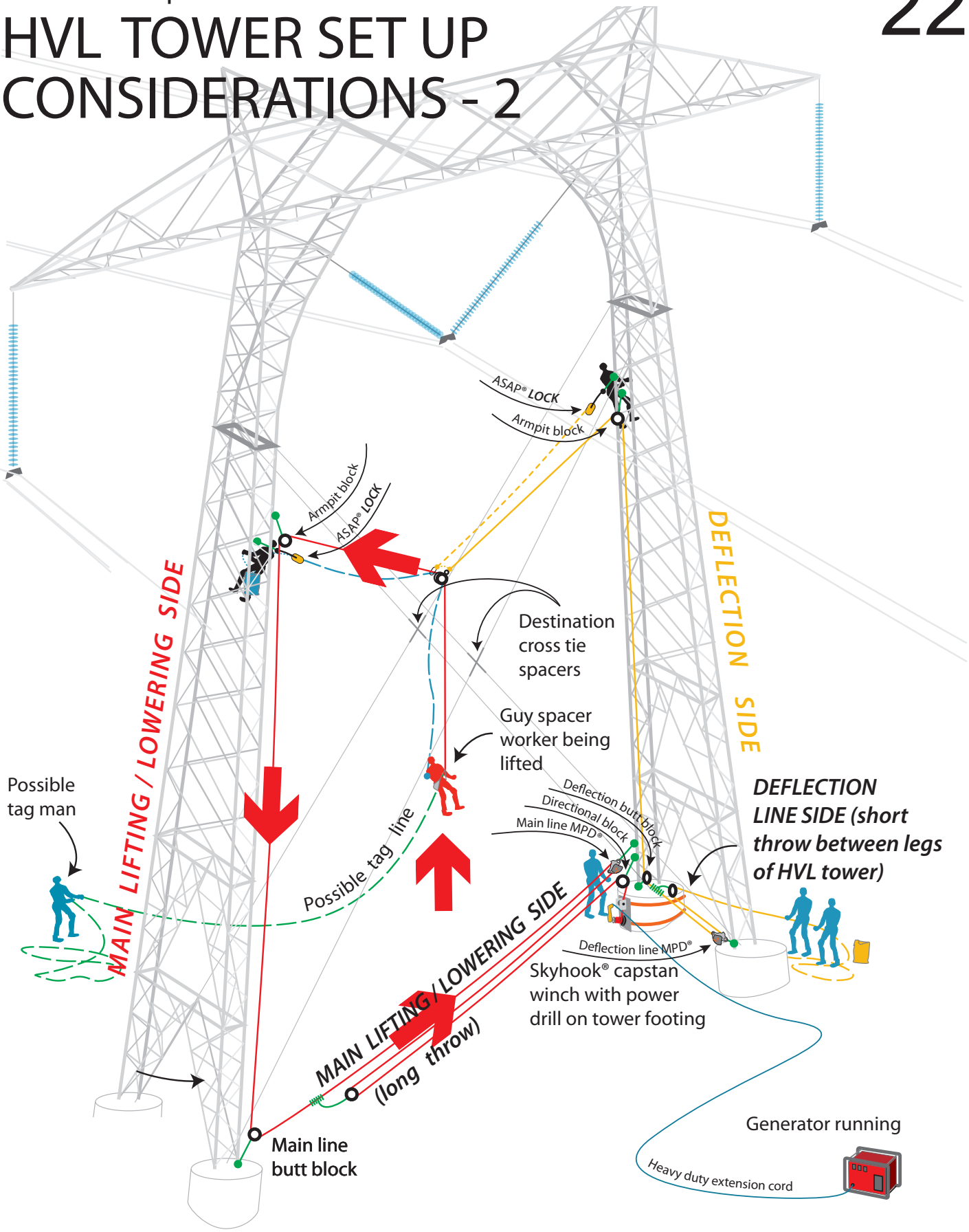
HVL TOWER SET UP CONSIDERATIONS - 1

21



HVL cross tie pre-form maintenance:

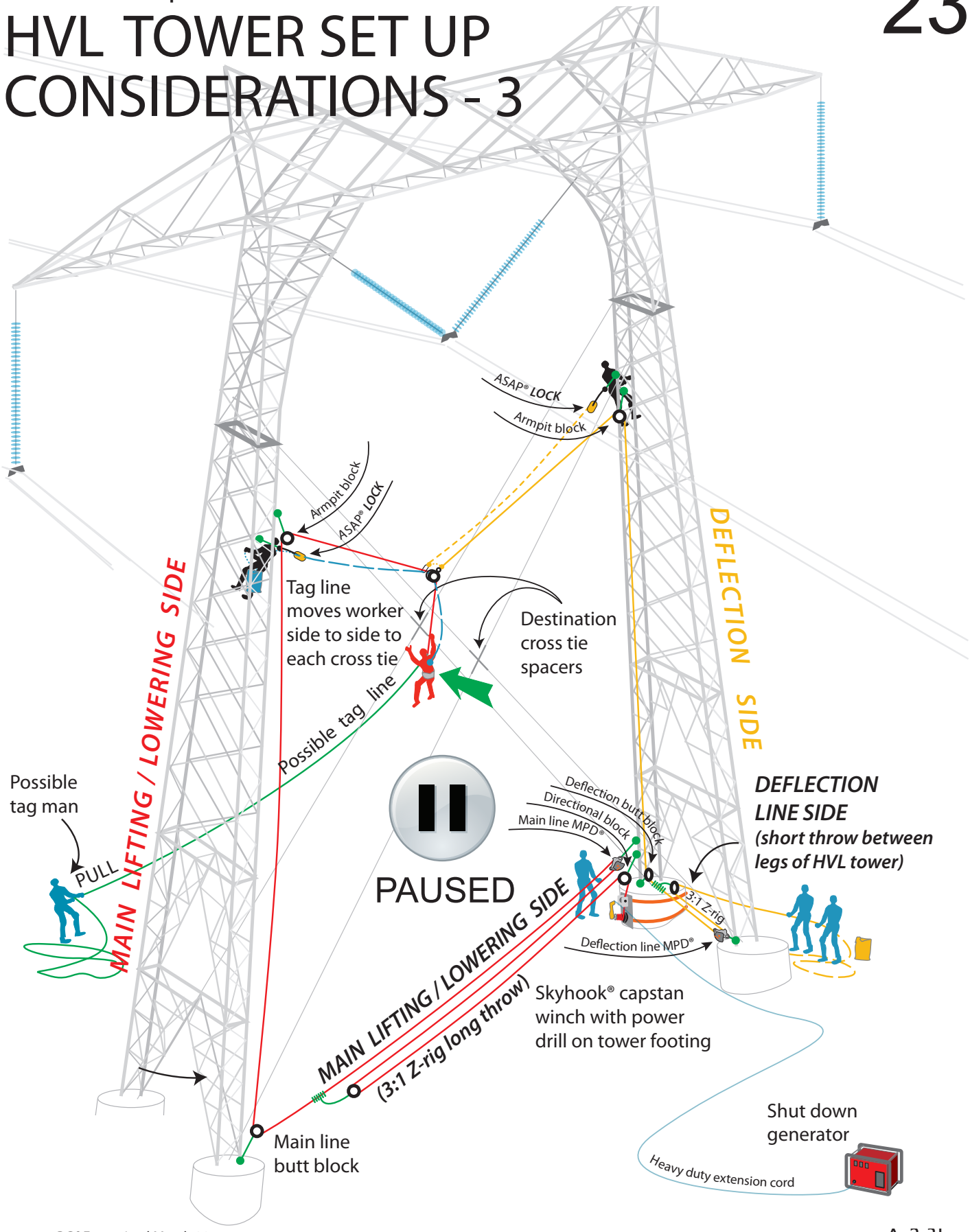
HVL TOWER SET UP CONSIDERATIONS - 2



HVL cross tie pre-form maintenance:

HVL TOWER SET UP CONSIDERATIONS - 3

23

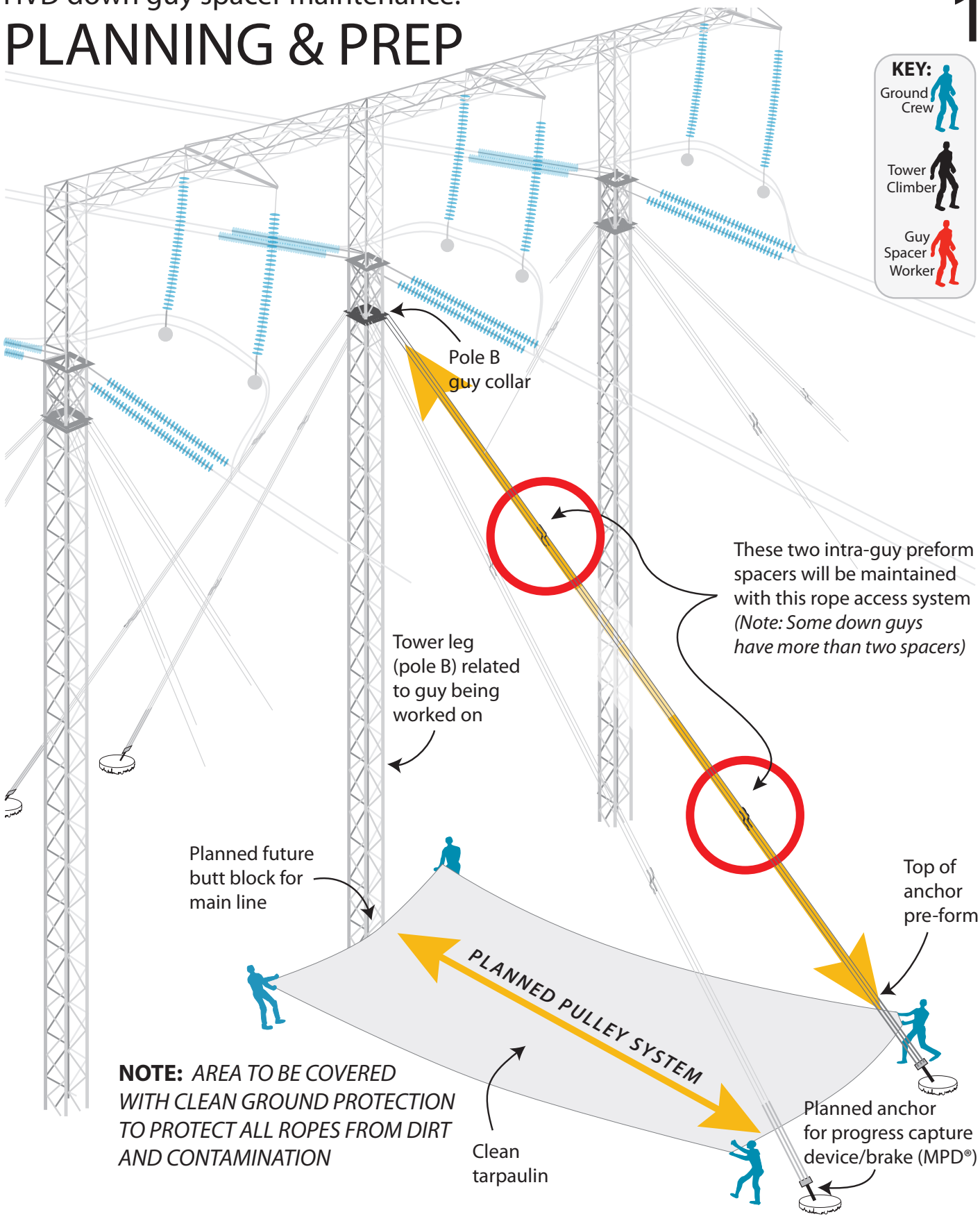


2.2.B HVD DOWN GUY SPACER MAINTENANCE

HVD down guy spacer maintenance:

PLANNING & PREP

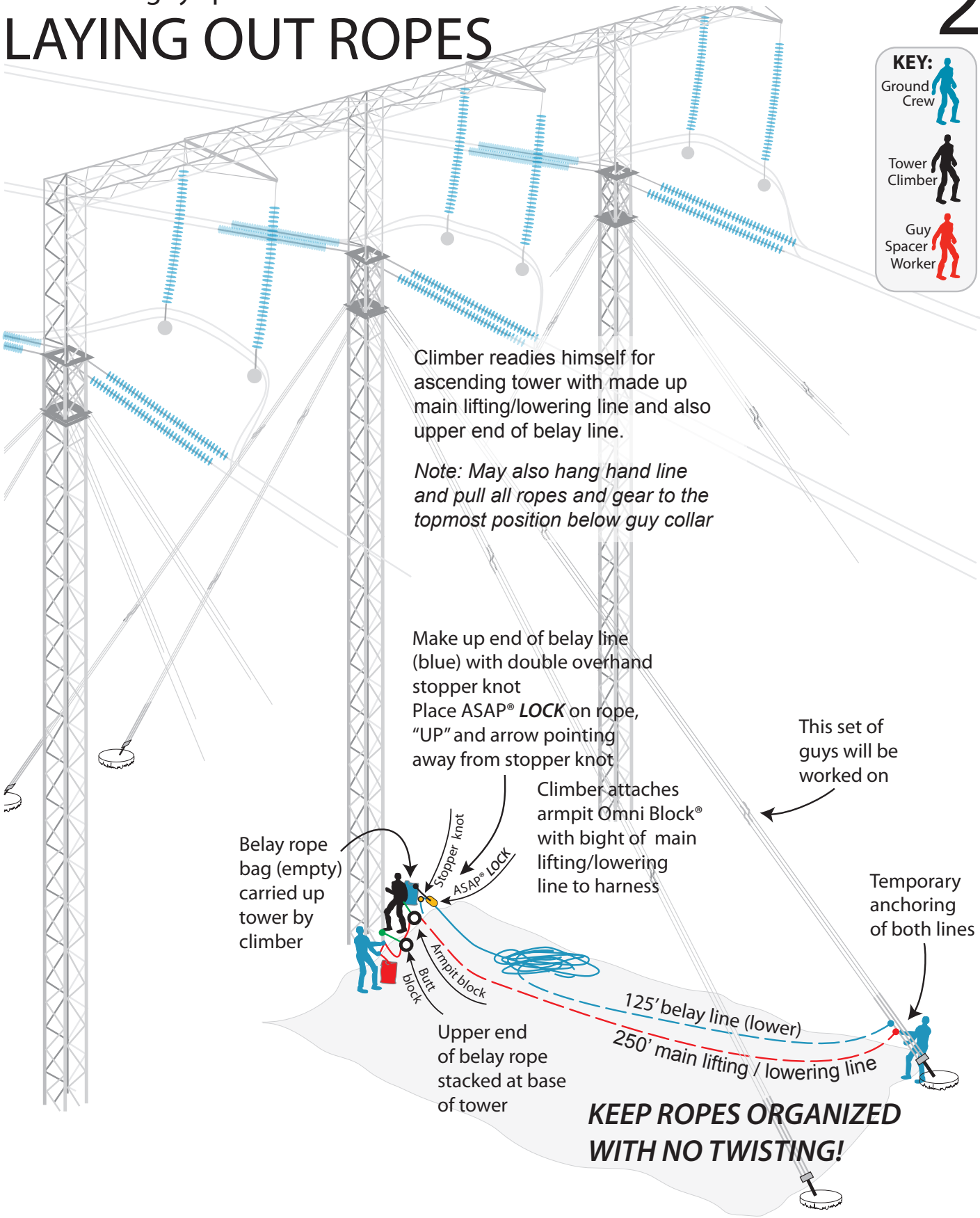
1



HVD down guy spacer maintenance:

LAYING OUT ROPES

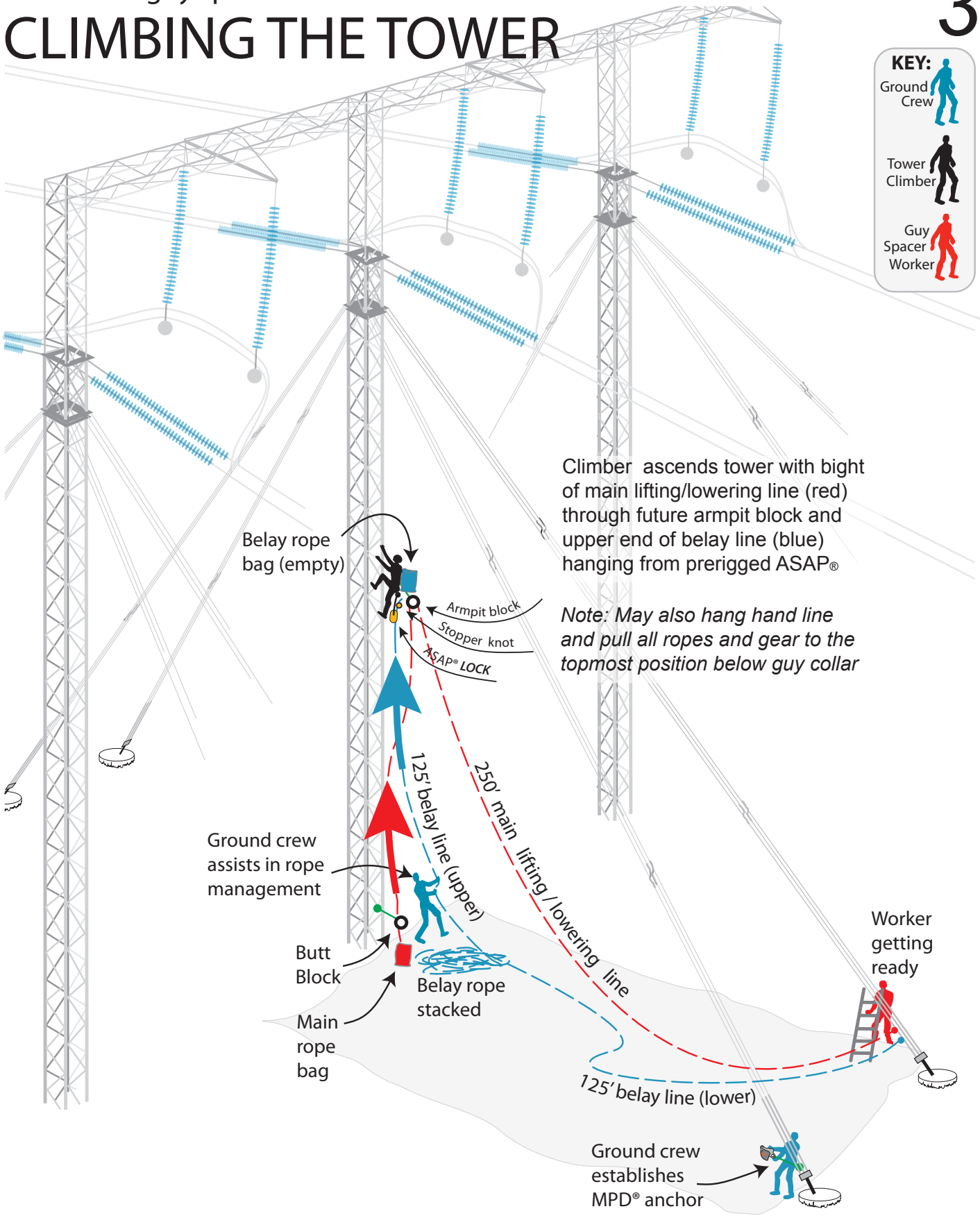
2



HVD down guy spacer maintenance:

CLIMBING THE TOWER

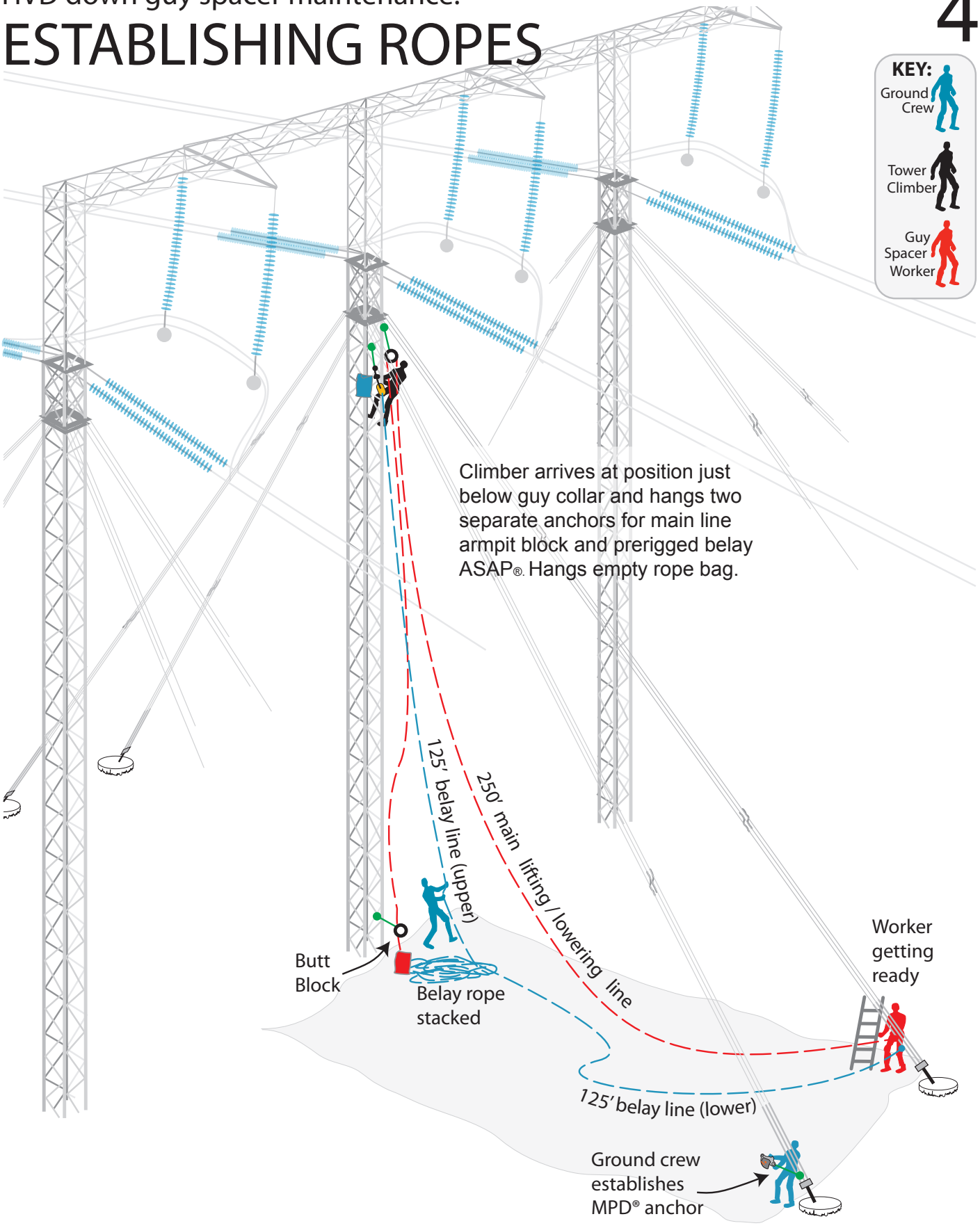
3



HVD down guy spacer maintenance:

ESTABLISHING ROPES

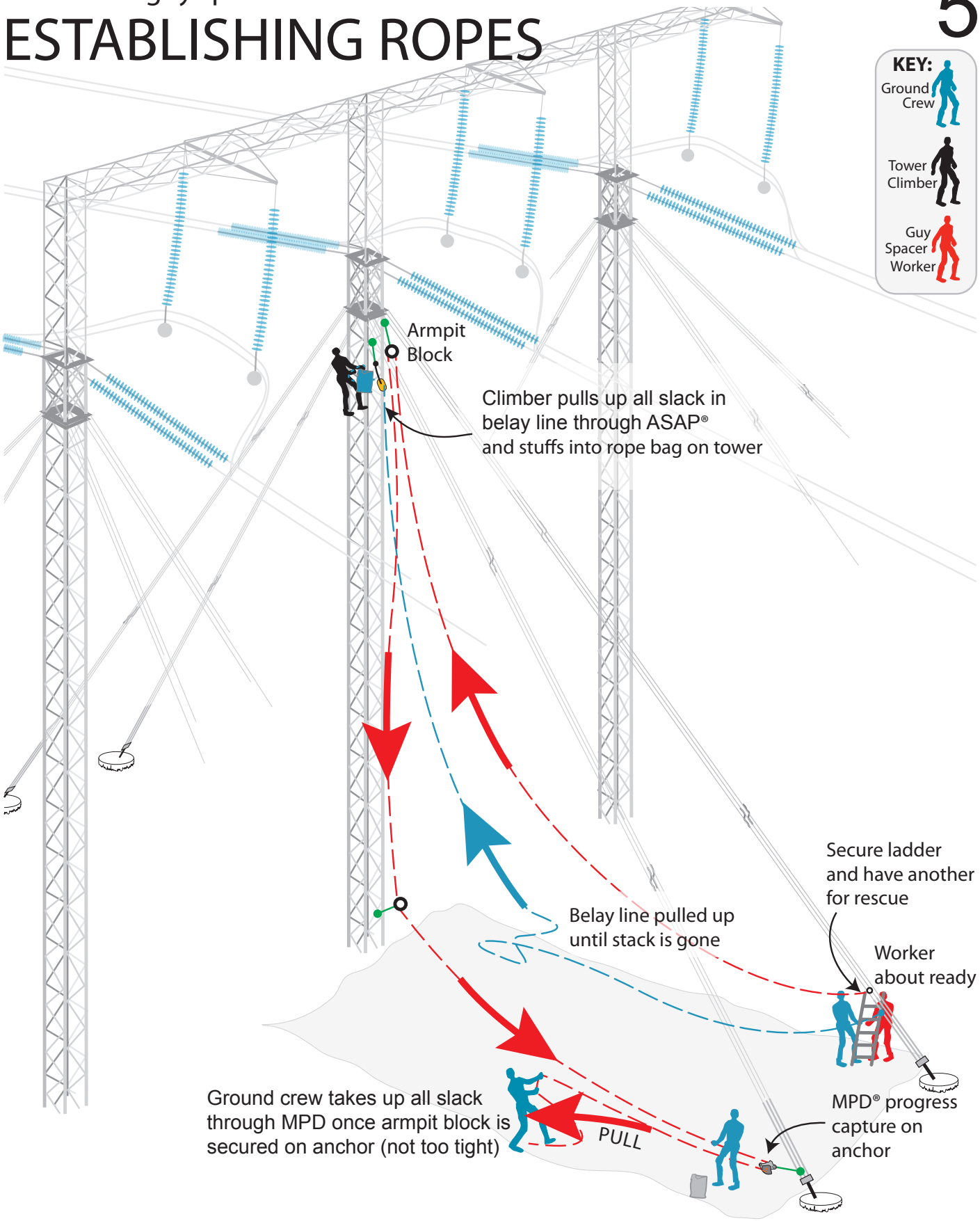
4



HVD down guy spacer maintenance:

ESTABLISHING ROPES

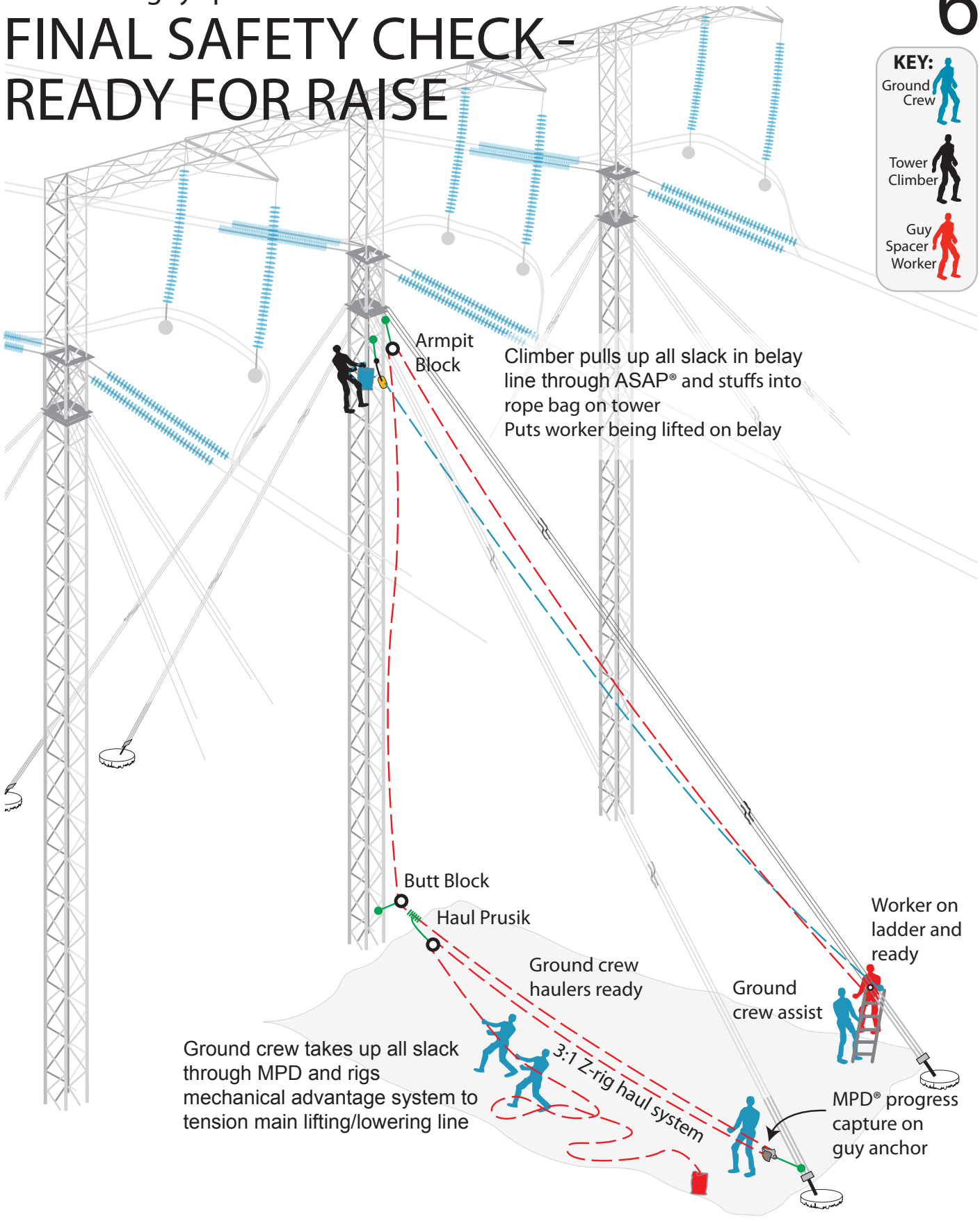
5



HVD down guy spacer maintenance:

FINAL SAFETY CHECK - READY FOR RAISE

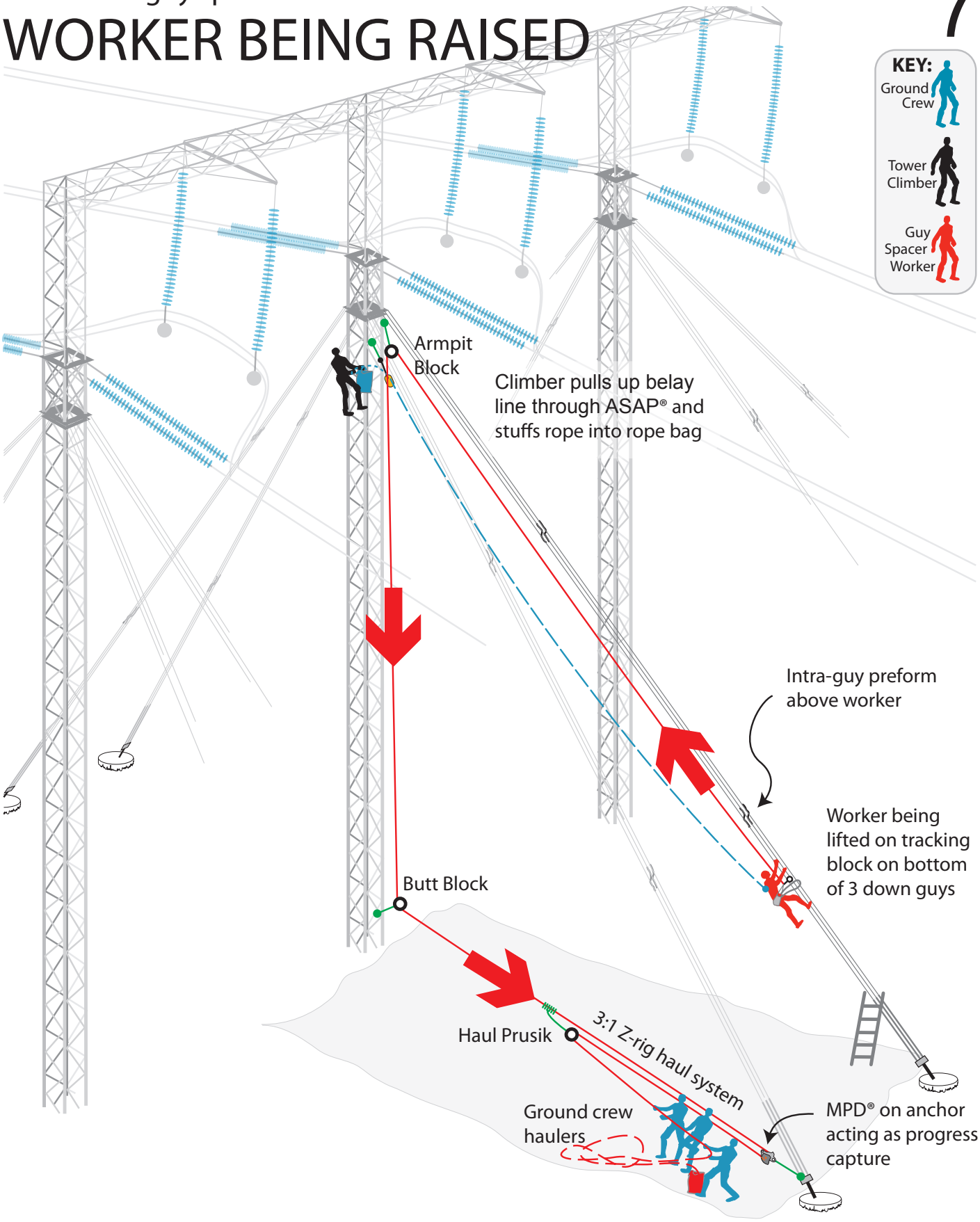
6



HVD down guy spacer maintenance:

WORKER BEING RAISED

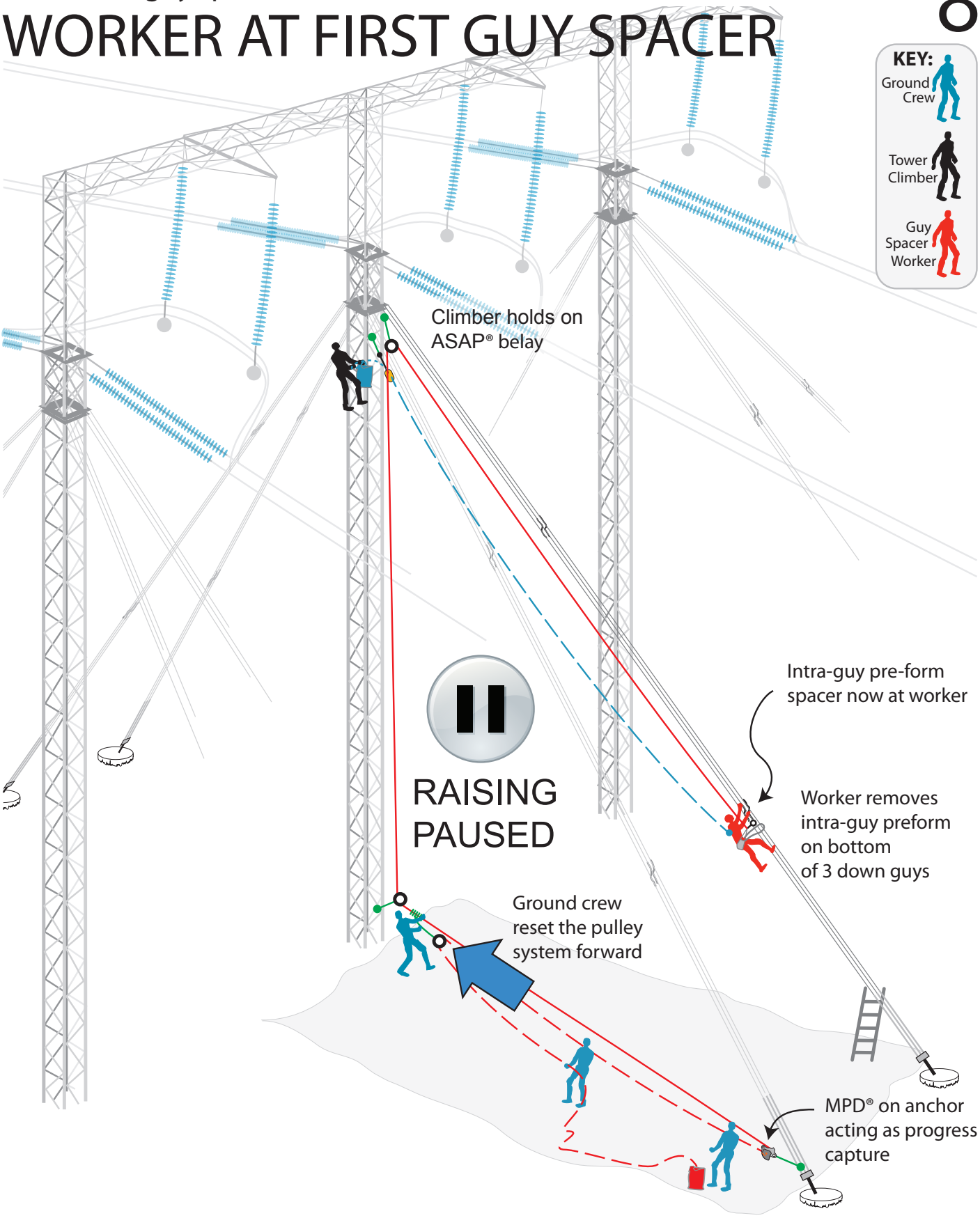
7



HVD down guy spacer maintenance:

WORKER AT FIRST GUY SPACER

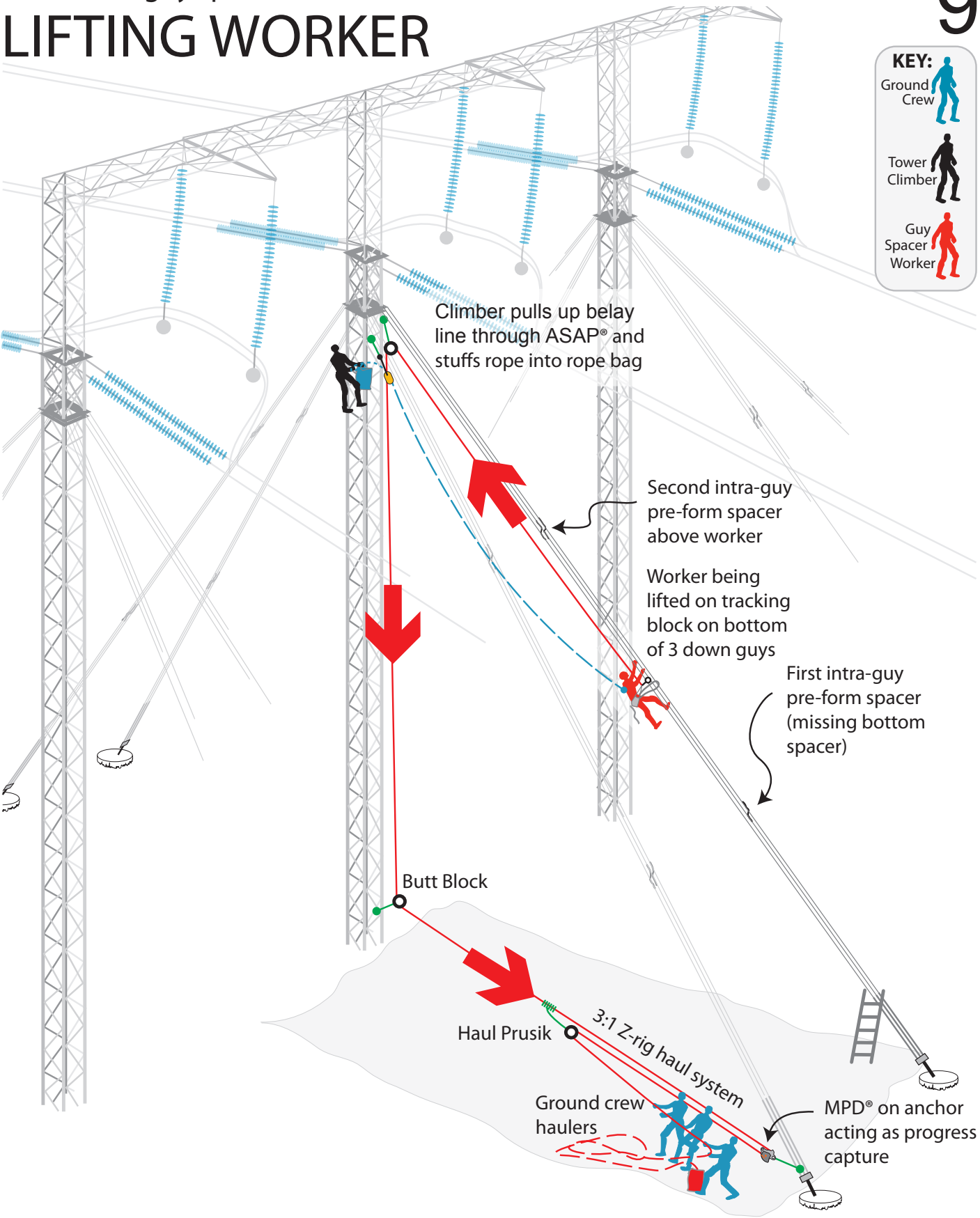
8



HVD down guy spacer maintenance:

LIFTING WORKER

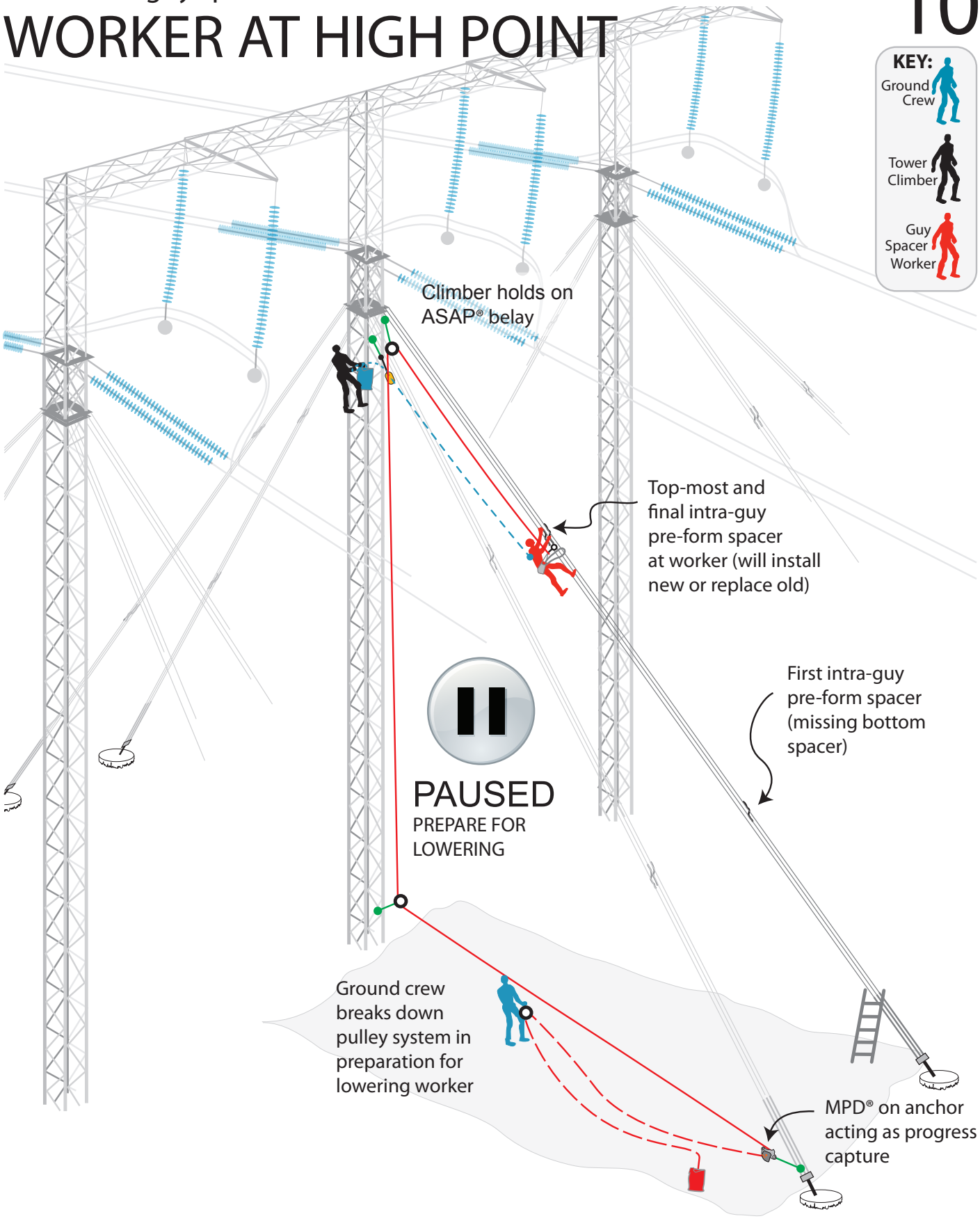
9



HVD down guy spacer maintenance:

WORKER AT HIGH POINT

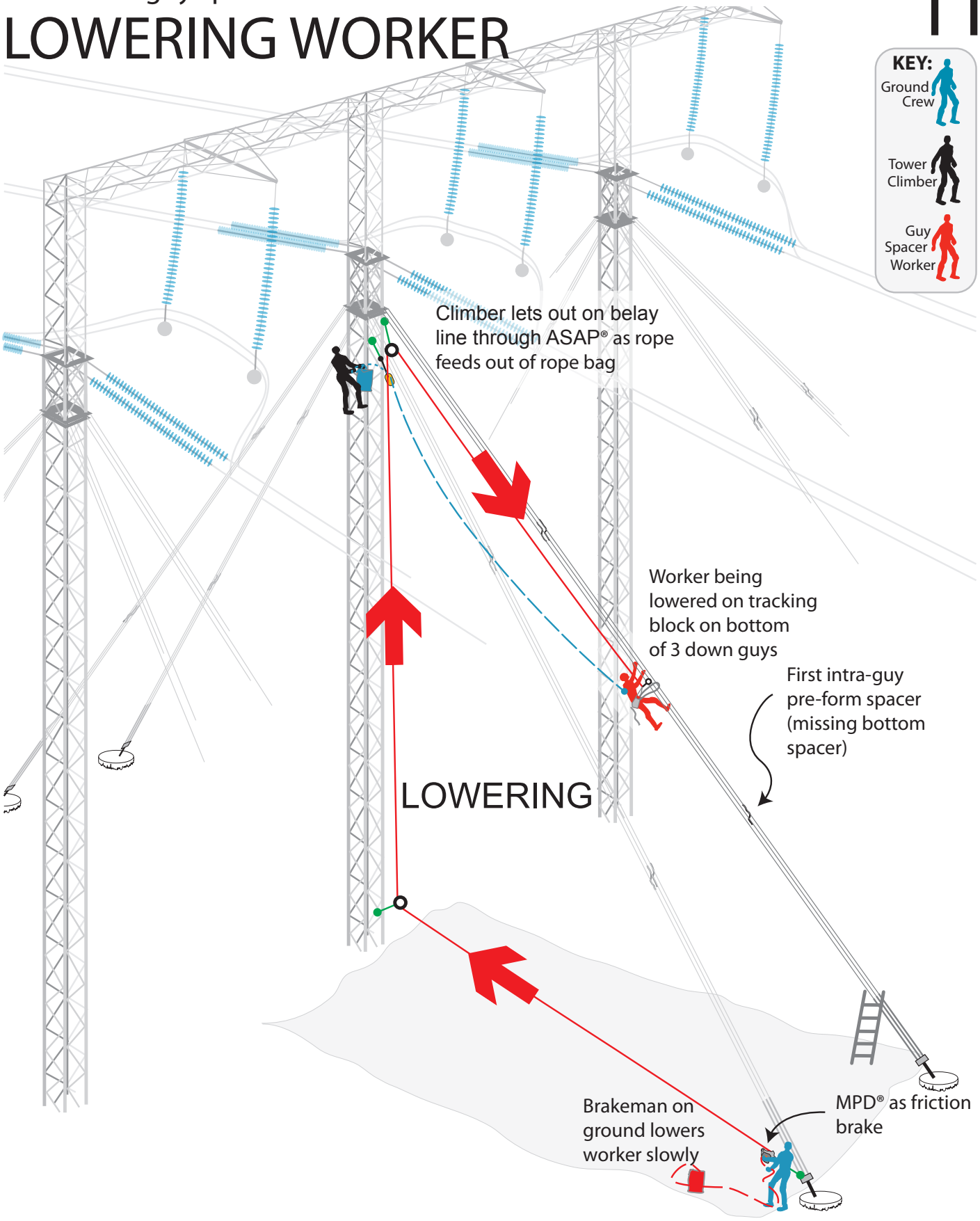
10



HVD down guy spacer maintenance:

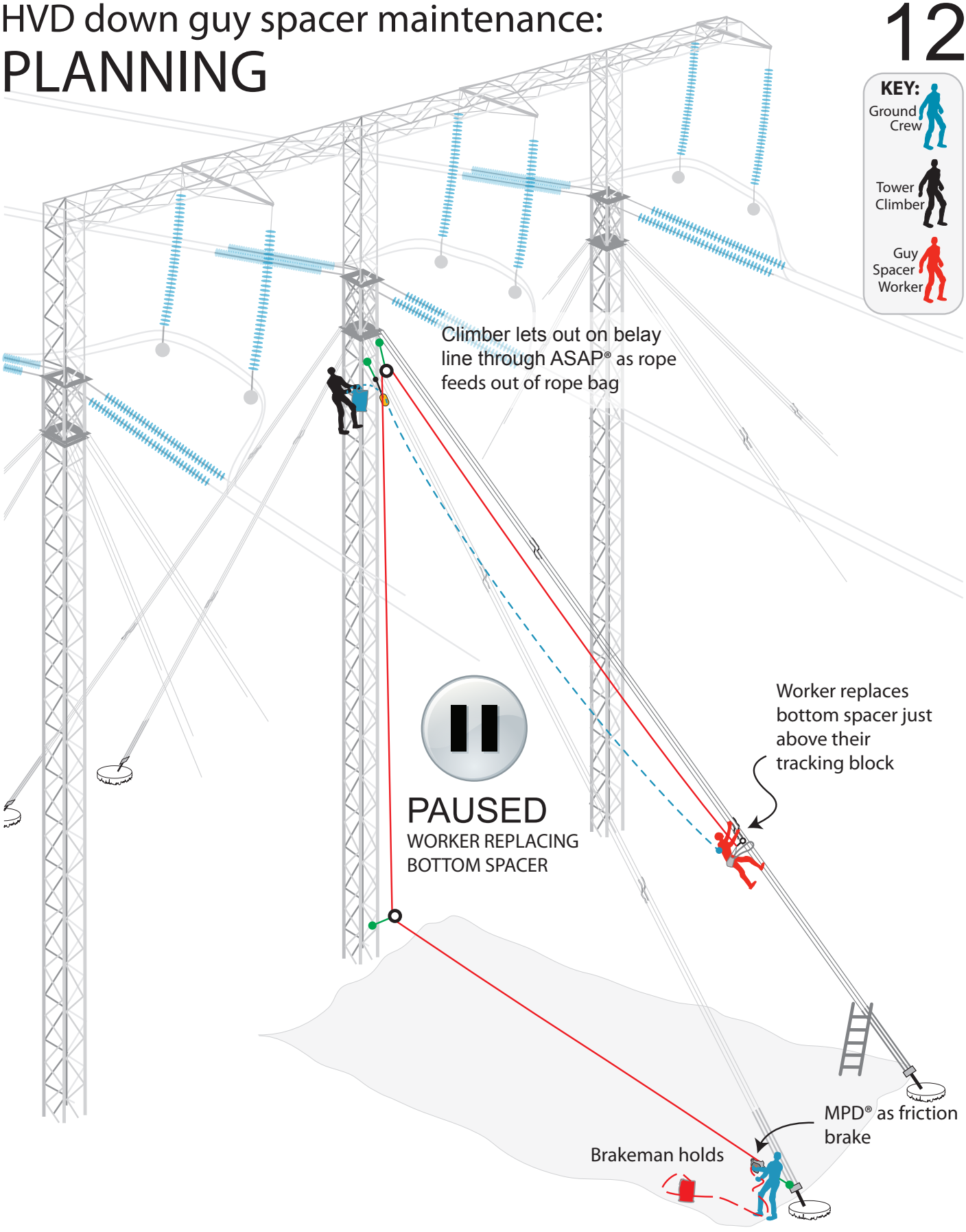
LOWERING WORKER

11



HVD down guy spacer maintenance: PLANNING

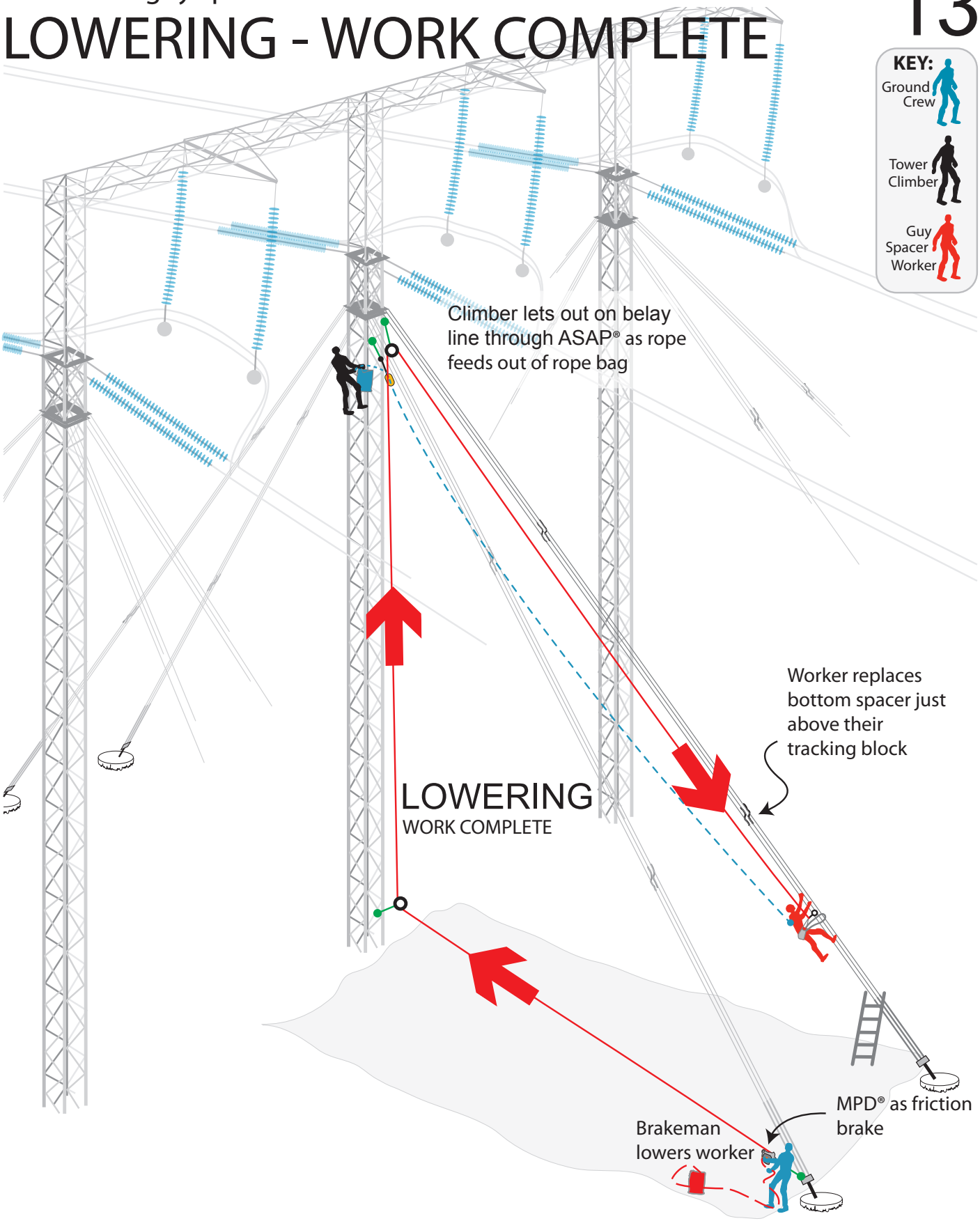
12



HVD down guy spacer maintenance:

LOWERING - WORK COMPLETE

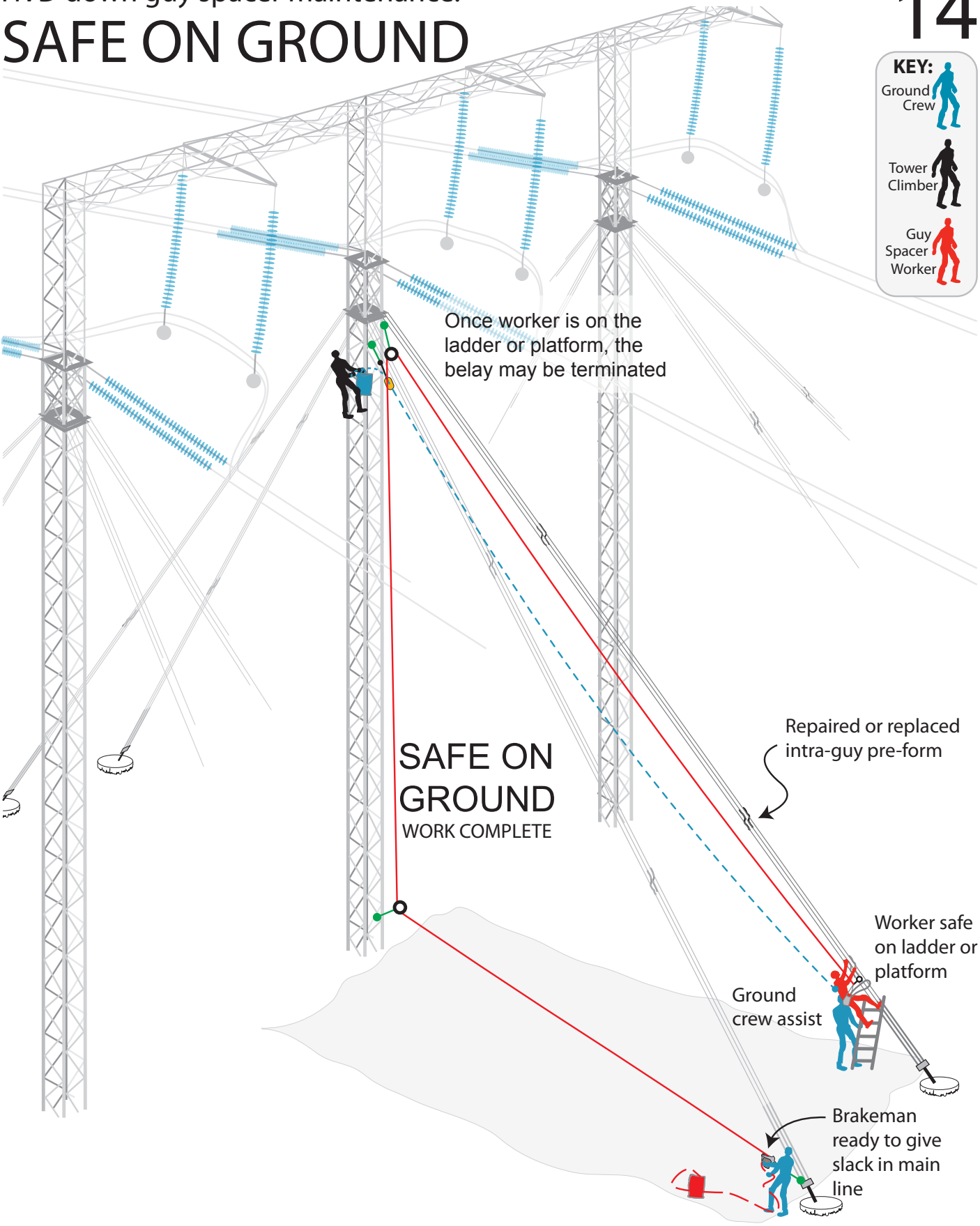
13



HVD down guy spacer maintenance:

SAFE ON GROUND

14



HVD down guy spacer maintenance:

DROP ROPES - TEAR DOWN

15