Supplementary Figure 1. a) Co-labeling of telomeres using KR-TRF1 and sgTelomere$^{(F+E)}$-directed dCas9-EGFP. **b)** Expression of KR-TRF1 in indicated cell lines. **c)** Expression of DsR-TRF1, KR-TRF1 and NLS-KR in U2OS cells. **d)** Stable expression of DsR-TRF1 and KR-TRF1 in HeLa cells used in Fig. 4 and Fig. 5. **e)** 8-oxoG staining in KR-TRF1 or DsR-TRF1 expressing HeLa 1.3 cells with light activation for 20 min. **f)** Kinetics of 8-oxoG at KR-TRF1 sites in transfected HeLa cells with or without light activation of KR, recovered in the dark for the indicated time.

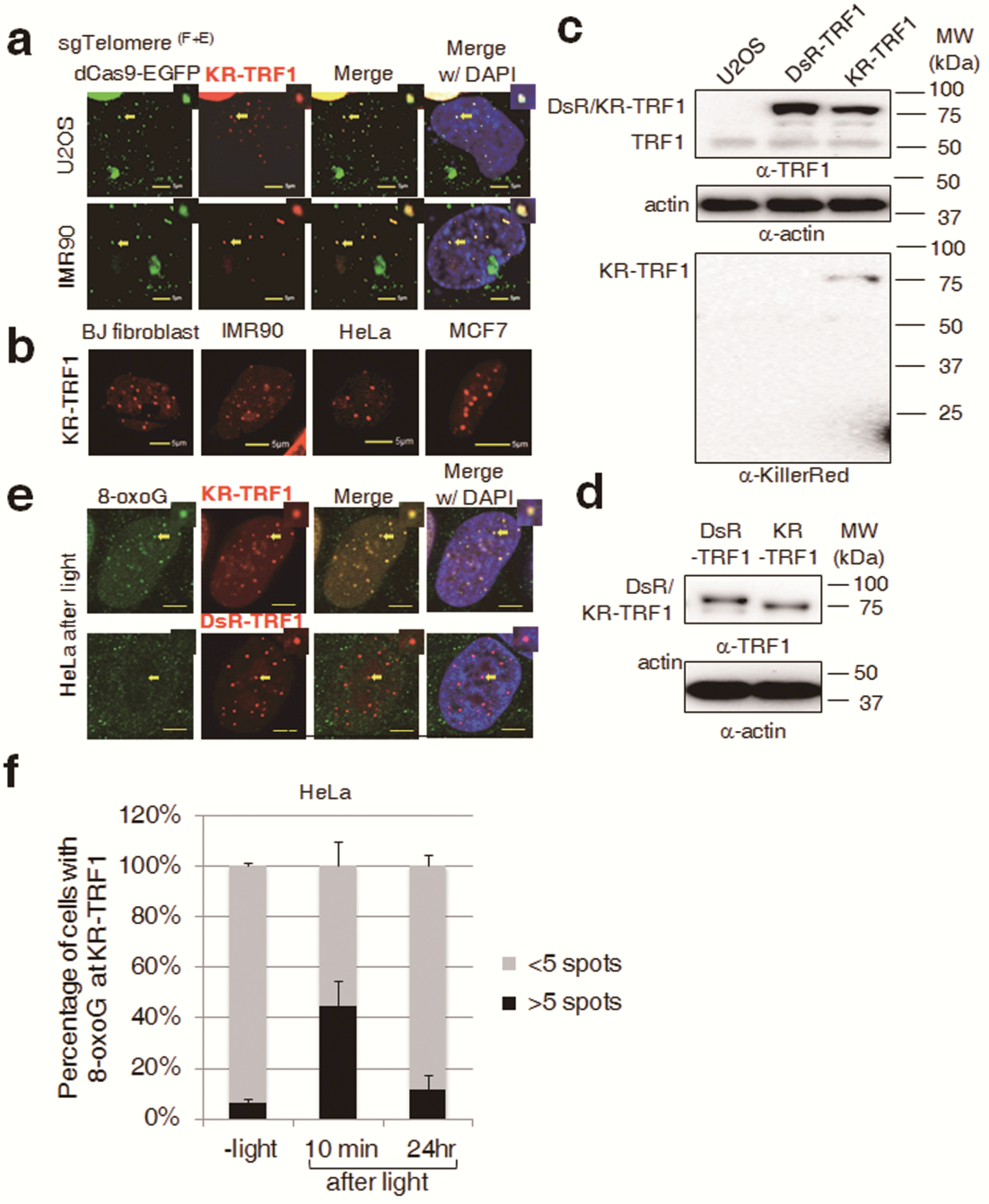
Supplementary Figure 2. Kinetics of DNA repair factor recruitment at telomeric site-specific damage. a-d) Recruitment of NTH1 (*a*), Polβ (*b*), FEN1 (*c*) and 53BP1 (*d*) to damage sites of KR-TRF1 at a single telomere spot in a single cell nucleus, or selected numbers of telomere spots as indicated with a yellow rectangle. **e)** Quantification of the percentage of cells showing co-localization with KR-TRF1 and Polβ or FEN1, with the indicated recovery time after 20 min of 15 W Sylvania cool white fluorescent bulb activation of KR. Mean values with a SD for 150 cells are given. P-value is calculated by Student's t-test, ** $P<0.005$. **f)** Staining of γH2AX (green) at sites of Flag-TRF1-fokI (red).

Supplementary Figure 3. Telomeric oxidative DNA damage induces cell cycle progression defects. a) Cell-cycle profiles of Flp-in T-REX 293 cells stably expressing KR-TRF1 with tetracycline induction. $1x10^5$ cells were seeded in 60 mm culture dishes and treated with cool fluorescent light for 2 hr, followed by the indicated recovery time in the dark. DNA contents were measured by propidium iodide staining for flow cytometry. The percentages of each cell-cycle phase at the indicated recovery time are shown. **b)** Percentage of cells in G1, S and G2/M phase was quantified in each cell after treatment as in (*a*).

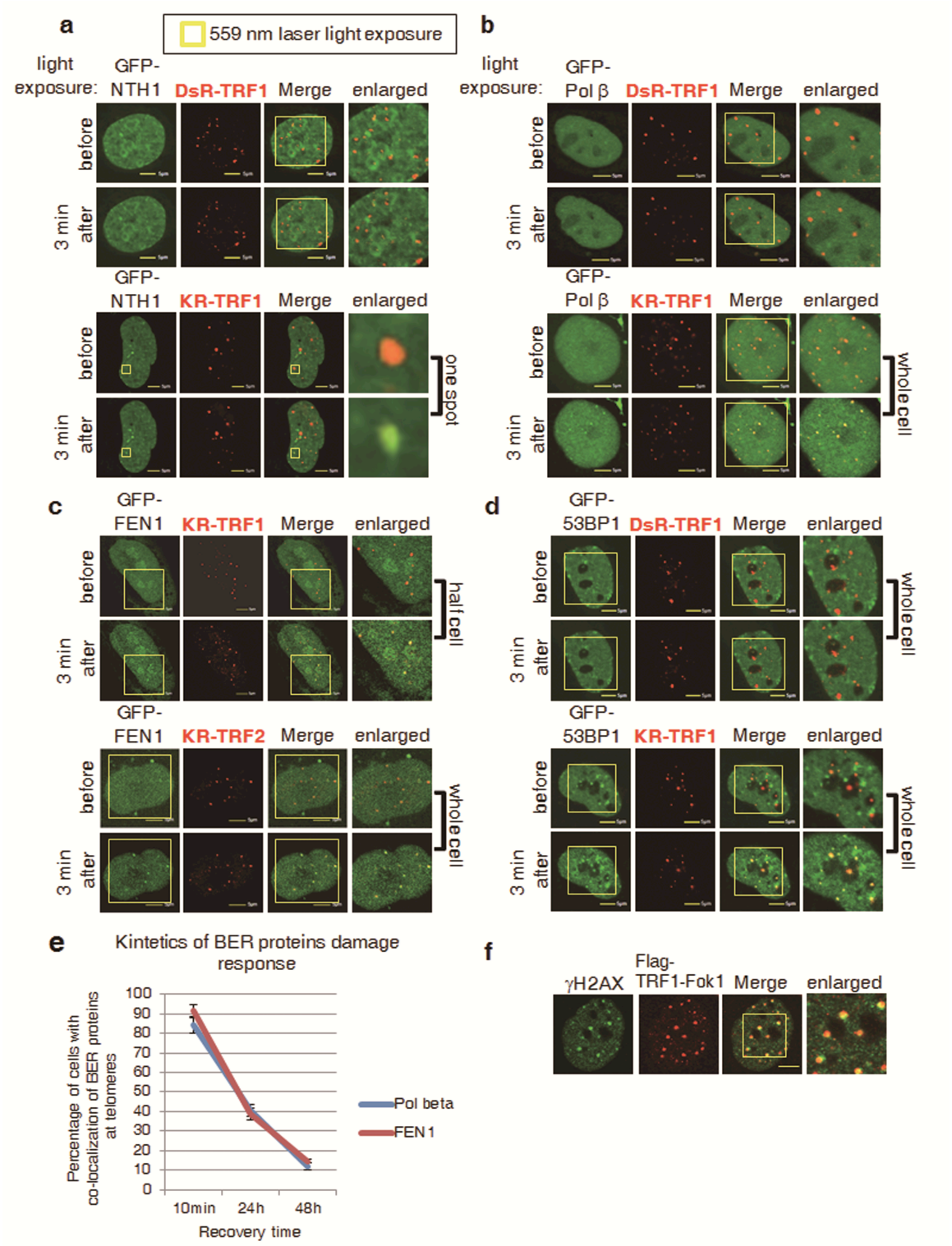
Supplementary video

Three dimensional image of KR-TRF1 (red) and DAPI (blue) in a U2OS cell nucleus by SIM. The 3D-SIM microscopy system was employed to carry out the 3D super-resolution imaging of U2OS cells. U2OS cells expressing KR-TRF1 were fixed with 3.7% (v/v) formaldehyde. The wavelengths of 405 nm and 561 nm were used to excite DAPI (blue) and KR-TRF1 (red) in the cell nucleus, respectively. The lateral resolution of the 3D-SIM image is ~100 nm and the axial resolution is ~240 nm.

Supplementary Figure 1



Supplementary Figure 2



Supplementary Figure 3