NON-DETERMINISTIC APPROACH TO AVAILABLE CAPACITY DISTRIBUTION FOR UNIT RECOURCE ASSESSMENT

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Introduction

1. Balance between between power being generated and being consumed at different nodes of power systems

2. Proposal – to consider the available power as resource capability in all power system elements and their connections:

- transmission lines,

- generators,

- power transformers,

- load circuits,

- nodes (at the substation buses).

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The available capacity is the apparent (installed) capacity of generating unit (power plant) minus the limitations of its capacity. Limitations are mainly connected to low efficiency of auxiliary system, quality of fuel, repair and reconstruction.

UPS data for 2022

Power Systems	Apparent Power, MW	Available Capacity, MW	Operational Capacity, MW
Central PS	50527	48337	37699
Mid Volga PS	27974	24644	20003
Ural PS	53448	50825	39314
North West PS	24870	22831	19476
South PS	27283	23056	19556
Siberia PS	52323	38123	30643
East PS	11242	10612	7212
Russia UPS, in total	247667	218390	173499

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Power generation growth in Russia
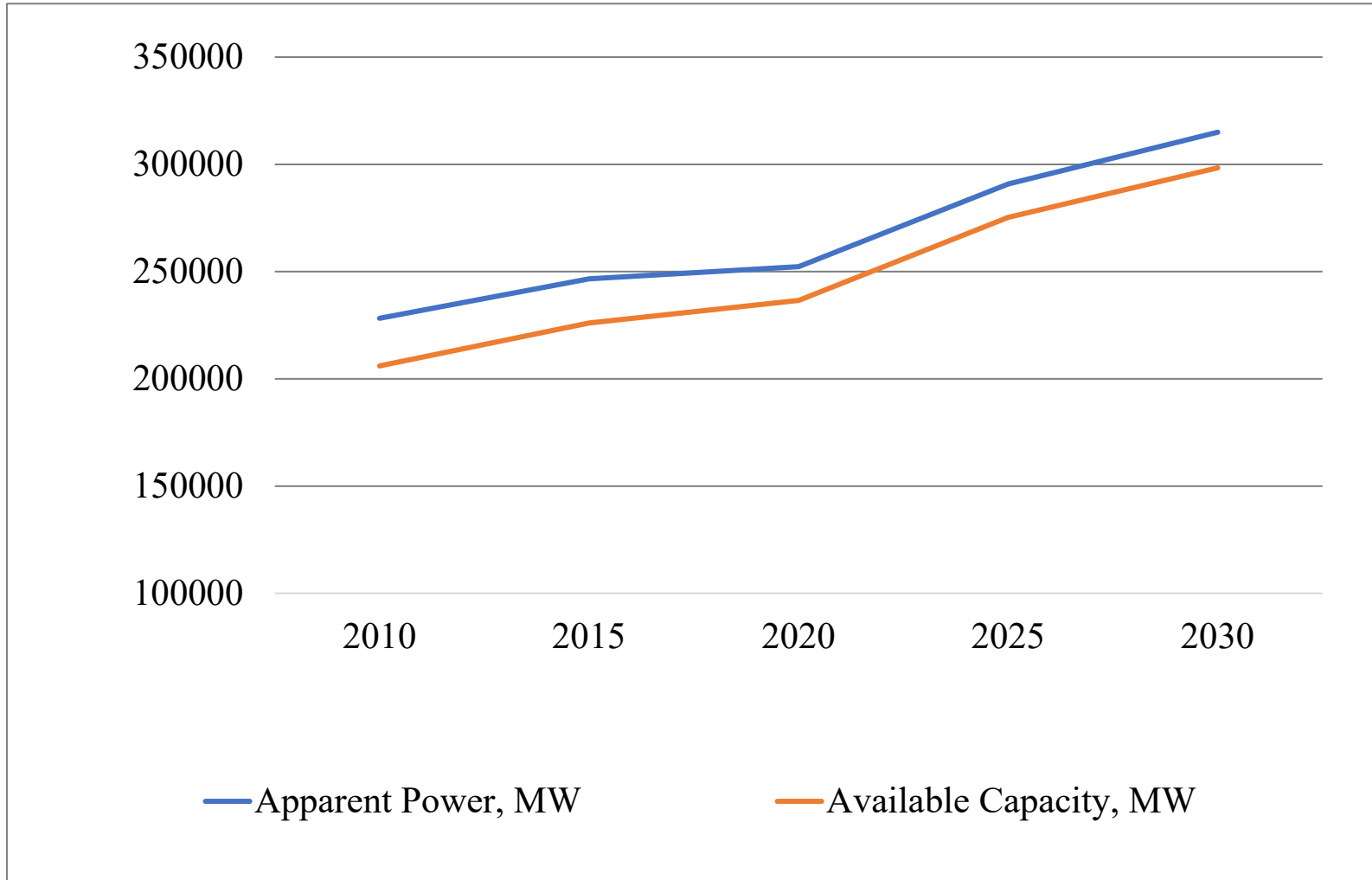
Risk $\mathbf{r_a}$ of exceeding the apparent power transformer capacity (r pt) by actual capacity (a pt)

$$r_a = p(S > s_{a\,pt}) = \int_{s_{r\,pt}}^{s_{a\,pt}} c_a(s)\,ds$$

Risk r_r of decrease in resource (available) capacity (a pt) of power plant compare to the apparent power transformer capacity (r pt)

$$r_r = p(S \leq s_{a\,pt}) = \int_{s_{av\,pt}}^{s_{a\,pt}} c_r(s)ds$$

Total risk

Defines the resource capability of power transformer.
Minimal risk value – optimal capacity of power transformer.

$$r_\Sigma = r_a + r_r$$

Conclusions

The designed approach provides possibility to optimal substantiation of:
- available capacity of power plant,
- power transformers and autotransformers rated capacity,
- cross-section of transmission lines,
- other scheme components.